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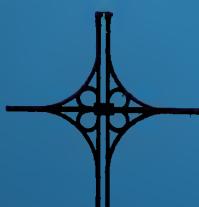
**BUTTE
URBAN
TRANSPORTATION
STUDY**

TECH - PLAN

REPORT NO. 1

TRAVEL SURVEYS

SEPTEMBER 1972



CLETE DAILY AND ASSOCIATES

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TECH PLAN
REPORT NO. 1
TRAVEL SURVEYS

BUTTE
URBAN
TRANSPORTATION
STUDY

For:

The Montana Department of Highways, Planning
Survey Section and the Butte - Silver Bow Transportation
Study Technical Advisory Committee.

In Cooperation With:

The U.S. Department of Transportation, Federal Highway Administration

By:

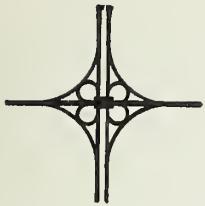
Clete Daily and Associates
Helena, Montana

The opinions, findings and conclusions expressed in this publication are those of the authors and not necessarily those of the Federal Highway Administration.

A faint, grayscale background image of a classical building with four columns and a triangular pediment. The building is centered and serves as a subtle backdrop for the text.

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CLETE DAILY AND ASSOCIATES

TRAFFIC ★ TRANSPORTATION ★ PARKING
CITY AND REGIONAL PLANNING

Technical Advisory Committee
Butte Urban Transportation Study
Butte, Montana

Gentlemen:

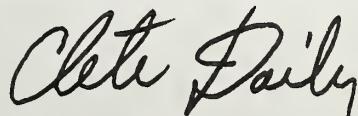
Enclosed herewith is Tech - Plan Report #1 covering the travel surveys phase of the Butte Urban Transportation Study. This report is the first in a series of five that will be published to document the specific work activities of the Study.

Comments on the draft report were received from the T.A.C., Montana Department of Highways (M.D.H.), and the Federal Highway Administration. Each comment was carefully considered and changes were made wherever necessary.

Our appreciation is extended to each of the aforementioned agencies for their assistance in the preparation of this report. Chapter III, covering Origin - Destination data collection, was prepared by the Montana Department of Highways.

Respectfully submitted,

CLETE DAILY AND ASSOCIATES



Clete Daily
Clete Daily, P.E.

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CHAPTER I

INTRODUCTION

I N T R O D U C T I O N

The purpose of this report is to document in detail, the methods used in the collection, editing, expansion and analysis of travel survey data for the Butte Urban Transportation Study Area. The work elements covered in this report were accomplished during the time period beginning with the initiation of the Study in July, 1970 to July 31, 1972.

Major benchmarks in the progress of the Study to this time are as follows:

Spring, 1970 - Montana Department of Highways at the request of the Butte-Silver Bow County City-County Planning Board initiates steps to carry out a transportation study for the Butte Urban Area. It is agreed that the City-County Planning Board will provide existing land use data, a future land use plan, and population, economic and employment projections as input into the Study. The Department of Highways agrees to collect area travel data and to carry out the necessary data processing and analyses to produce a recommended 1990 Major Street and Highway Plan.

July, 1970 - Montana Department of Highways begins field work on travel surveys.

February, 1971 - Montana Department of Highways completes field work on travel surveys. Manual editing and coding of travel survey data begins.

Fall, 1971 - Keypunching and verification of travel survey data begins.

March, 1972 - Keypunching and verification of travel survey data is completed. Montana Department of Highways contracts with Clete Daily and Associates to complete remainder of the Study by March 22, 1973 (12 months). An interim time of four months is specified in which an assignment of future traffic to the existing plus committed system will be completed.

The development of a transportation plan for the Butte area is the first step in the continuing transportation planning process. Following publication of the transportation plan by the consultant, other reports may be prepared by the Montana Department of Highways or other agencies to reflect the population and employment trends. A series of five Tech-Plan Reports will be prepared to document the study methods and findings of this first step in the transportation planning process. The work activities to be covered in each report, are as follows:

Tech-Plan Report 1: Travel Surveys

- For outline, see TABLE OF CONTENTS of this report.

Tech-Plan Report 2: Base Year - Traffic Assignment, Trip Generation, Gravity Model Calibration

- Development of 1970 Network
- Traffic Assignment to 1970 Network
- Base Year Trip Generation Variables
- Development and Analyses of Trip Generation Equations
- Gravity Model Calibration

Tech-Plan Report 3: Forecast Year - Land Use Distribution, Trip

Generation, Traffic Assignment to E+C

- Forecasting Procedures
- 1990 Land Use Distributions
- 1990 Trip Productions and Attractions
- Development of Existing plus Committed Network
- Traffic Assignment of 1990 Trips to the Existing plus Committed Network

Tech-Plan Report 4: Supplemental Studies - Parking, Transit, and TOPICS

Tech-Plan Report 5: Testing and Analyses of Alternate Systems

- Development of Alternate Systems for 1990
- Traffic Assignments to 1990 Alternate Systems

This report deals with the Travel Survey phase of the Study. This phase has been divided into seven work elements which are covered in detail in Chapters II through VII.

Chapter II lists detailed definitions for the technical terms which are used throughout this and subsequent reports.

Chapter III was prepared by the Montana Department of Highways, Planning Survey Division, the agency in charge of data collection. This chapter outlines the procedures used in selecting the samples to be interviewed and procedures followed in conducting the travel surveys.

Chapter IV covers the procedures used by the consultant to edit the travel survey computer data cards to check for data collection, coding or keypunch errors.

Chapters V and VI outline the procedures used to develop expansion factors used to convert the various survey data to total vehicular travel data. Expansion factors were cross-checked using independent population and household data.

Chapter VII describes the screenline checks which were used to compare the travel survey data with actual ground counts taken during the data collection period. The methods used to adjust the travel survey data are outlined in detail. Zone to zone trip tables tabulated from the adjusted 1970 travel data are shown in Appendix A.

CHAPTER II

DEFINITIONS

D E F I N I T I O N S

Throughout the transportation planning process and in subsequent reports, certain terms will be used to refer to activities and elements of the study. Many of these terms have a unique meaning for this particular study. To clarify the meaning of these terms, a glossary of definitions has been prepared. Terms are listed in alphabetical order to facilitate reference.

Base Year - Year in which Travel Surveys were conducted - 1970.

Butte Urban Transportation Study - Surveys and analyses of existing and future vehicular travel on the street and highway system serving the Butte urban area. The end result of the Study will be a plan for developing a street and highway system capable of meeting 1990 travel needs.

Census Data - The 1970 census information as compiled April 1, 1970 by the United States Bureau of Census.

Cordon Line - An imaginary line delineating the Butte Urban Transportation Study Area.

Data Edit - The manual or computer checking of data to determine validity.

Dwelling Unit - Living quarters occupied or intended for occupancy by a household or by a person living alone or by a group of persons living together. It may consist of one or more rooms. If a

single room, it is a dwelling unit if it has one or more of the following:

1. Separate cooking facilities
2. The only living quarters in a structure
3. A one-room apartment in an apartment house

If a group of two or more rooms, it is a dwelling unit if it has one or both of the following:

1. Separate cooking facilities
2. A separate entrance, either directly from the outside or from a common hall

External Surveys - A portion of the Origin - Destination Travel Survey conducted at the cordon line to determine travel data by interviewing motorists at each major vehicular crossing.

Forecast Year - Future year for Transportation Plan - 1990

Internal Surveys - A portion of the Origin - Destination Travel Survey including the home interview survey, truck survey, and taxi survey. Data regarding household characteristics and travel by local vehicles was collected by these surveys.

Origin - Destination Travel Survey - A series of five (5) interview surveys conducted in the Butte urban area to determine the origin and destination of trips made by vehicles passing through the area, vehicles traveling within the area, and trips made by trucks and taxis.

Screenline - An imaginary line, usually located along a major geographical barrier such as a river or railroad track, splitting the study area into two parts. Traffic classification counts - and possibly interviews - are conducted along this line. The actual vehicular crossings are compared to those calculated from the interview data as a check of the internal survey accuracy.

Traffic Analysis Zone - A portion of the study area, delineated for land use and traffic analyses purposes. It may be a subdivision or the study area used for conducting the data collection phase of study or the analyses of specific details pertaining to the study, such as trip productions and attractions.

Travel Survey Data Cards - Data processing cards containing the data collected by the five travel surveys. The cards are referred to by the following identification numbers:

Card #1 - household characteristics from the home interview survey.

Card #2 - trip data from the home interview survey.

Card #3 - trip data from the external survey.

Card #4 - trip data from the truck survey.

Card #5 - trip data from the taxi survey.

Trip - The one-way travel, by a single mode of travel, between a point of origin and a point of destination.

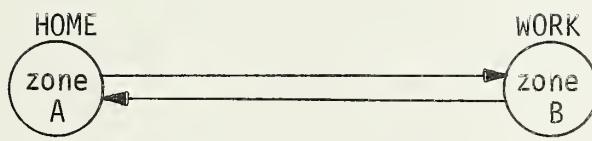
Trip Destination - The end point of a trip.

Trip File - A record containing a listing of all internal and external trips for the Butte metropolitan travel study area.

Trip Origin - The beginning point of a trip.

Trip Purpose Stratification - Trips from the Origin - Destination Travel Survey have been categorically classified according to trip purpose. Three classifications are used - home based work (HBW), home based other (HBO) and non-home based (NHB). Further explanations and examples follow:

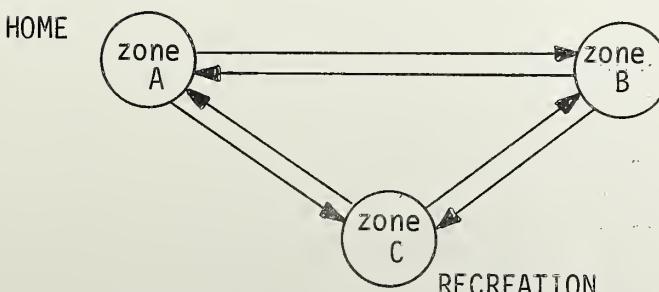
HBW - A trip made for the purpose of going to or leaving work, with at least one trip end at home.



Employee proceeds from home in zone A to work in zone B at 7:30 am, and reverses course at 5:30 pm.
Result: 2 HBW trips

HBO - A trip made for any purpose other than work, with at least one trip end at home.

NHB - A trip made for any purpose, with neither end at home.



Trips between zones A and B and A and C represent four HBO trips. Trips between zones B and C represent two NHB trips.

Trip Table - A matrix showing the number of trip interchanges between each pair of sections, districts, traffic analysis zones, or other

subdivision of the study area.

Zone Centroid - An assumed point in a district or traffic analysis zone that represents the center of activity and the origin and destination of all trips to or from the zone.

CHAPTER III

METHODS AND PROCEDURES
USED FOR CONDUCTING
THE TRAVEL SURVEYS

METHODS AND PROCEDURES
USED FOR CONDUCTING
THE TRAVEL SURVEYS

EXTERNAL ORIGIN AND DESTINATION

Interview Stations

Eight roads and highways, seven of which are on the Federal Aid Highway Systems, connect Butte to the surrounding part of the State. Interview stations were located on six of these roadways at points along the external boundary of the study area. Traffic at these six stations amounted to 98.9% of the total traffic on all road crossings of the external cordon line. In relation to the urban area, these six interview stations were located on Interstate 15 to the northeast, Interstate 90 to the southeast, U.S. 10 to the southeast, FAS 393 to the south, Interstate 15 and 90 to the west, and FAS 276 to the northwest. Because of very light traffic, a cordon crossing on FAS 440 leading to a rural area southwest of town and a crossing on old U.S. 10 to Rocker were eliminated as interview sites.

Scheduling

Interviewing at these six stations was distributed over ten working days between July 29 and August 11, 1970, and when working at low volume stations, the interviewing crew was split so that two stations were covered. This was done for both work shifts. Morning shifts were from 6 a.m. to 2 p.m.; afternoon shifts were from 2 p.m. until 10 p.m. or darkness. The schedule was arranged so that a morning and afternoon

shift for a given station fell on the same day of the week for two consecutive weeks.

Procedures and Quality Control

All outbound traffic at each station was interviewed except for short peak hour periods, when "stored" vehicles were intentionally flagged through several stations without interview. In this circumstance, the "stored" vehicles would be flagged through, then interviewing would resume and continue until the number of "stored" vehicles would again become excessive.

The regular interviewing staff for the Butte external study consisted of five interviewers - college students hired for the summer - and one permanent status field supervisor.

Quality control during the interviewing consisted of editing completed interview sheets, informing the interviewer of errors and inconsistencies in his work, monitoring at random the telephone interviews and seeking immediate corrective actions as necessary. Though the interviewers had received earlier training and some had previous experience in origin and destination surveys, one of the lower volume stations on the Butte external cordon was scheduled for the first day's interviewing to give the supervisor time to observe and talk with individual interviewers.

The only significant weather problem for the Butte external interviewing was a rain and thunderstorm during the afternoon shift of August 8, at the station located on Interstate 15 northeast of Butte. The

station was closed for several hours and interviews were taken at a later date for the hours missed.

THE INTERNAL DWELLING UNIT SURVEY

Sample Selection

The dwelling unit universe for the internal survey of the urban transportation study was a land use parcel listing supplied by the Butte City-County Planning Board. This listing, printed by computer, was based on a sidewalk-windshield survey made in the spring and summer of 1968. Although the listing appeared accurate for the period when it was compiled, it was somewhat out of date when used preparatory to the home interview operation in the fall of 1970. Many buildings - whole city blocks in some cases - had been demolished in the two intervening years. A June, 1969 aerial photograph, the most recent one then available, was used prior to sample selection to eliminate demolished buildings from the parcel listing in selected uptown areas where the heaviest demolition had occurred. Later, during the home interviewing operation, it became apparent that many additional buildings had been demolished in the 15 months from the time the photo had been made.

A 20% sample was then drawn from dwelling units identified on the parcel listing, based on sample rates in the FHWA "Manual of Procedures for Home Interview Traffic Study", October 1954, as updated. Two random numbers equal to or less than ten were drawn for each major planning district within the study area. Using these random numbers, every 5th residence was then listed by district, block, parcel, and dwelling unit

numbers. Each sample household was then located and marked on an excellent, well detailed set of land use maps from the City-County Planning Board. These land use maps had been prepared in a manner highly correlated to the land use computer listing. The associated street address for each sample was then entered on the sample lists. These addresses were later cross checked during the home interview operation with mailing addresses of electricity customers of the Montana Power Company. This cross check was valuable because the electric meter records indicated - on a reasonably current basis - whether a meter was in use or had been disconnected at a particular dwelling unit. Later, in a field check operation during the home interviewing, it was then determined whether the "disconnect" was vacant or demolished.

During the sampling procedure it was observed that dwelling unit information relating to the larger apartments, residential hotels and low-cost housing developments was not included on the city-county planning board land use listing. These large multiple residences were eliminated from the main dwelling listing and were placed on a separate list. Later, during the interviewing of the main dwelling sample, these places were field listed and were grouped into a separate, supplemental dwelling unit universe. This supplemental universe was then sampled in a manner identical to the earlier sampling of the main universe.

Study Publicity

The local newspaper, radio and television stations gave good coverage to the urban transportation study. Brief radio and television advertisements were also carried by the radio and television stations on a

public service basis. The study supervisor felt that some additional, paid commercials would have been helpful to the overall study effort.

In addition to the public information effort, a letter of notification was also sent to occupants of sample residences. This letter, signed by the Mayor of Butte and the Chairman of the City-County Planning Board, informed the occupants of the approaching interview and asked them to keep a record of trips made on a specified weekday on a "travelog" which was enclosed. This mailing campaign was carried out by the study staff on a semi-weekly basis in addition to regular interviewing duties. The timing of the mailings was quite critical as postal sorting and deliveries turned out (in previous tests) to be somewhat erratic timewise. The letters could not be mailed too far in advance of the travel-date or the recipients would misplace the letters or forget to keep the travelogs. Arriving too late, the letters would be of no use and would be a possible source of embarrassment.

Almost all people who were later interviewed were aware they had received the letter; an estimated 90% read the letter; and about 40% also made some use of the travelog.

Since the interviewing was largely by telephone, a third sheet enclosed with the letter and travelog was soon found to be helpful. Many residences in Butte have unlisted numbers and others have family members who work odd shifts of the day. This sheet asked these people to call the interviewing office at their convenience between 8 a.m. and 9 p.m. to have their interview taken, and a member of the study staff was present at all times for these calls. Approximately 100 of these odd-hour

interviews were taken, so the sheet was considered a definite assistance. No record was kept of the total number of unlisted numbers.

Interviewer Selection and Training

Six women telephone interviewers were selected at the beginning of the Butte study from a list supplied by the Personnel Section, Montana Department of Highways. These women carried a major responsibility as they later completed a major portion of the internal area dwelling unit interviews. Based on returns from the quality control operations, as well as supervisory evaluation, these six women became good to excellent interviewers.

Six men field interviewers - a maximum of four at any one time - and one woman telephone interviewer were eventually hired from prospects who had been initially screened by the Butte office of the Montana State Employment Service. The field workers selected were all young men under 25 years of age, and several were students at Montana College of Mineral Science and Technology.

Training consisted of several hours of formal instruction, which was rapidly followed by practice interviewing. The women responded very well to actual interviewing followed by short sessions in which various experiences were shared and discussed. These questions were organized on a daily basis for the first several weeks and were later cut back to one a week as proficiency and understanding increased. Actual telephone interviewing began on the second day of employment.

Interview Procedure and Quality Control

The main internal survey for the Butter Urban Transportation Study was a telephone interview procedure, supplemented with field interviews. About 75% of the interviews were taken by telephone and the other 25% were taken in person at the dwelling unit.

All samples were originally assigned to a telephone interviewer who then called until the interview was completed or until it was established that 1) the occupants of a sample residence could not be contacted by telephone during the interview hours, 2) the occupants had no telephone or 3) someone in a nearby residence thought the sample address to be vacant or demolished. A telephone interview was considered complete only in the event the occupants of a sample residence had been questioned and the interview had been examined and passed by a supervisor. If an interview had not been completed due to one of the reasons listed above, it was then assigned to a field interviewer, who completed the interview or verified the final survey status of the dwelling unit.

Quality control procedures were extensive, including manual edits, re-contacts and entire re-interviews. If a "completed" interview was not complete in some regard in the initial inspection, it was generally handed back to the same interviewer who then recontacted the people at the sample residence and attempted to finish the interview. If this re-contact was not successful, the people having refused or otherwise unable to cooperate, a supervisor then telephoned the residence or the interview was referred to a field interviewer, depending on circumstances. Due to the unusual conditions which existed in the uptown

area, including the large number of vacant and demolished buildings, and the large number of elderly and retired people, the study supervisors felt that interview forgeries were a definite possibility. With this possibility in view, most telephone interviews which indicated one of these situations were field checked by a field interviewer, and the field interviewers were randomly checked in turn by study supervisors.

In terms of completed interviews, numerous recalls were made by supervisors and field interviewers to check unusual conditions, especially the situation of no reported work trips, or the situation of a large family with few reported trips. One day's output of each telephone interviewer out of each two week period was randomly selected for supervisory checks or complete field re-interviews under the pretense of "misplaced" interviews. All checks of this nature were made on the same interview date, or on the first work day following. Approximately 270 interviews selected by this random procedure were either intensively checked or completely re-interviewed. This was about 10% of all sample residences. Hours of work for the telephone interviewers were 10 a.m. to 2 p.m. and 3:30 p.m. to 7:30 p.m. Hours for the field interviewers were deliberately staggered; first, to accommodate several part-time students, and second, to have interview hours available other than those of the telephone interviewers. This was necessary as "swing shifts" and unusual work hours are quite common in Butte.

Interview Scheduling

Assigned travel dates were scheduled for weekdays, Monday through

Friday. An interview date was the day following the travel-date, which meant the interviewing week was Tuesday through Saturday, with Sunday and Monday off.

The main dwelling unit sample consisted of 2,665 interviews which were originally divided equally among 29 travel-dates between Thursday, October 15, 1970 and Wednesday, November 26, 1970, with one State holiday skipped. This meant an almost equal distribution of travel dates among days of the week. The last three travel-dates were postponed one full week due to severe weather conditions and icy streets. With six telephone interviewers, and 92 interviews scheduled per interview date, this meant a daily load of 15-16 interviews per interviewer. This daily interview load appears high, but with numerous vacant, demolished and single person residences, the load was not considered excessive.

The supplemental dwelling unit sample of apartments, boarding houses, etc., consisted of 252 interviews which were evenly divided among five travel-dates between December 3rd and 9th. Truck interviews were also scheduled for this same period.

In all cases, interviews were assigned to interviewers on a random basis, to keep all work loads evenly distributed.

Factors Influencing the Home Interview Data

One complication for the home interview operation was a period of snow and inclement weather which settled over Butte on Wednesday, November 18, 1970. During the first 4½ weeks of the survey, the autumn days had been clear and sunny. The severe weather arrived after the

23rd scheduled travel-date of the main dwelling unit sample. Notification letters had previously been mailed out for the week of November 30, December 1 and December 2. Fortunately, the weather broke on November 27, the day after Thanksgiving, and icy streets thawed and were essentially bare through the end of the interview period. For the dwelling unit sample, this meant that driving conditions were good to excellent for about 90% of the survey period.

The study results may have been slightly impaired by community reaction to a number of other major city-wide planning efforts which had been started earlier. Many people in the urban transportation sample had previously been interviewed during one of several home interview surveys, and by the U.S. Census in April and May of 1970. Most people interviewed in the transportation study were cooperative and helpful, so the impairment was considered to be minor.

TRUCK SURVEY

Sample Selection

For sampling purposes, the State of Montana truck registration files for Silver Bow County were selected as the most current and perhaps only reliable source of a truck universe for the Butte Urban Transportation Study. As there is little development in Silver Bow County outside the urban area, all trucks were assumed to be in the urban area until later proven to be outside.

Truck registration receipt cards for 1970 were first sorted by gross vehicle weight into four subgroups as follows: 6,000#, 8,000#

to 14,000#, 16,000# to 24,000#, and 26,000# and over. This sampling stratification has been found to be necessary in several other studies in Montana to insure a data return for the larger truck units. Trucks of the first group, which were pickups, were sampled with the dwelling unit survey, and were excluded from further processing. Trucks of the latter three groups were sorted separately by license plate numbers and every third truck was selected for interview from a random start. Sample lists were then started with license and receipt numbers, and were completed by adding the name and address of the registered owner from the registration receipt.

The final truck sample was composed of 33.3 percent of the 1,023 trucks registered in Silver Bow County. Three hundred forty-one (341) samples were chosen, 30 of which could not be located in the study area and 40 which were positively located outside the study area.

Interview Procedure

Interviews for the truck survey were scheduled for a two week period with assigned travel-days starting Monday, November 30, and ending Friday, December 11, 1970. Interviews of truck drivers were conducted largely in person. The owner, manager and/or dispatcher was first called by telephone to 1) inform him of the study purposes; 2) obtain consent to interview the driver, and 3) to make arrangements to contact the driver at a suitable time and place. In some cases, if it was then feasible to call the driver at his home, the interview was taken by telephone. If a driver was to be interviewed at a work site, the interview was taken in person.

TAXI SURVEY

Methods and Procedures

Data on taxi trips was obtained from the two taxi companies by an interviewer personally calling on the owner or manager. The desired data was on the company central dispatch records and on the vehicle fee sheets. With the permission of the owner or manager, these records were Xeroxed for a recent, randomly selected travel-date and the original copies were then returned to the company. Trip records were obtained from the City Taxi Company for December 1, 1970 and from the Owl Cab Company for December 8, 1970. Since all trips made by all vehicles are included on the coding sheets for the selected travel-date, the samples were later expanded by a factor of 1.00.

OTHER CONSIDERATIONS

There was a time lapse between taking the external survey (July and August, 1970) and the screenline counts and home interviews (November, 1970). The external origin and destination study was completed before the decision was made to proceed with a complete transportation study.

Only auto-driver and transit passenger trips were recorded during the home interviews. One question asked during the home interviews and the answer coded on the dwelling unit summary card was the "number of occupants making regular trips on Butte Transit Company buses". The areawide response to this question was negligible. Numerous elderly respondents went to great lengths to describe how they made essential

trips with friends, relatives or the taxis other than taking the bus.

Following completion of the internal and external surveys, the Montana Department of Highways completed the coding, keypunching and verification of the sample interviews.

CHAPTER IV

TRAVEL SURVEY DATA EDITS

TRAVEL SURVEY DATA EDITS

The consultant used FHWA 1401 edit routines to check the validity of the travel survey data. Figure IV-1 shows the steps followed in editing the data cards. The household data cards (card #1) were edited using the PRKTAB computer program.

Preliminary edits of the household data cards showed an unusually high number of interviews with no reported trips. To determine the reason for this, the original field interview sheets for all samples with no reported trips were manually examined. Tables IV-1 and IV-2 summarize the results of that examination. Table IV-1 shows that 43.3 percent of the samples did not report trips. Table IV-2 gives a breakdown of those samples with no trips reported. A total of 217 samples were considered non-interviews because they were vacant lots, commercial establishments, refusals or incomplete interviews; these were excluded from the internal survey. Another 205 samples were found to be vacant dwelling units. Vacant dwelling units were also included in the 1970 Census dwelling unit tabulations, which were used for expansion. These 422 samples representing samples from which no trips were possible accounted for a total of 32.6 percent of the no trip reported samples.

Of the remaining 869 samples with no trips reported, 471 reported a retired head-of-household, and an additional 118 reported no autos. The manual examination uncovered 56 coding errors which gave an erroneous tabulation of no trips reported. Nine of these were corrected and added to the file. The remaining 47 were rejected. The remaining 224 samples consisted of 206 non-retired households with an auto and

DATA EDIT FLOW CHART

FIGURE IV-1

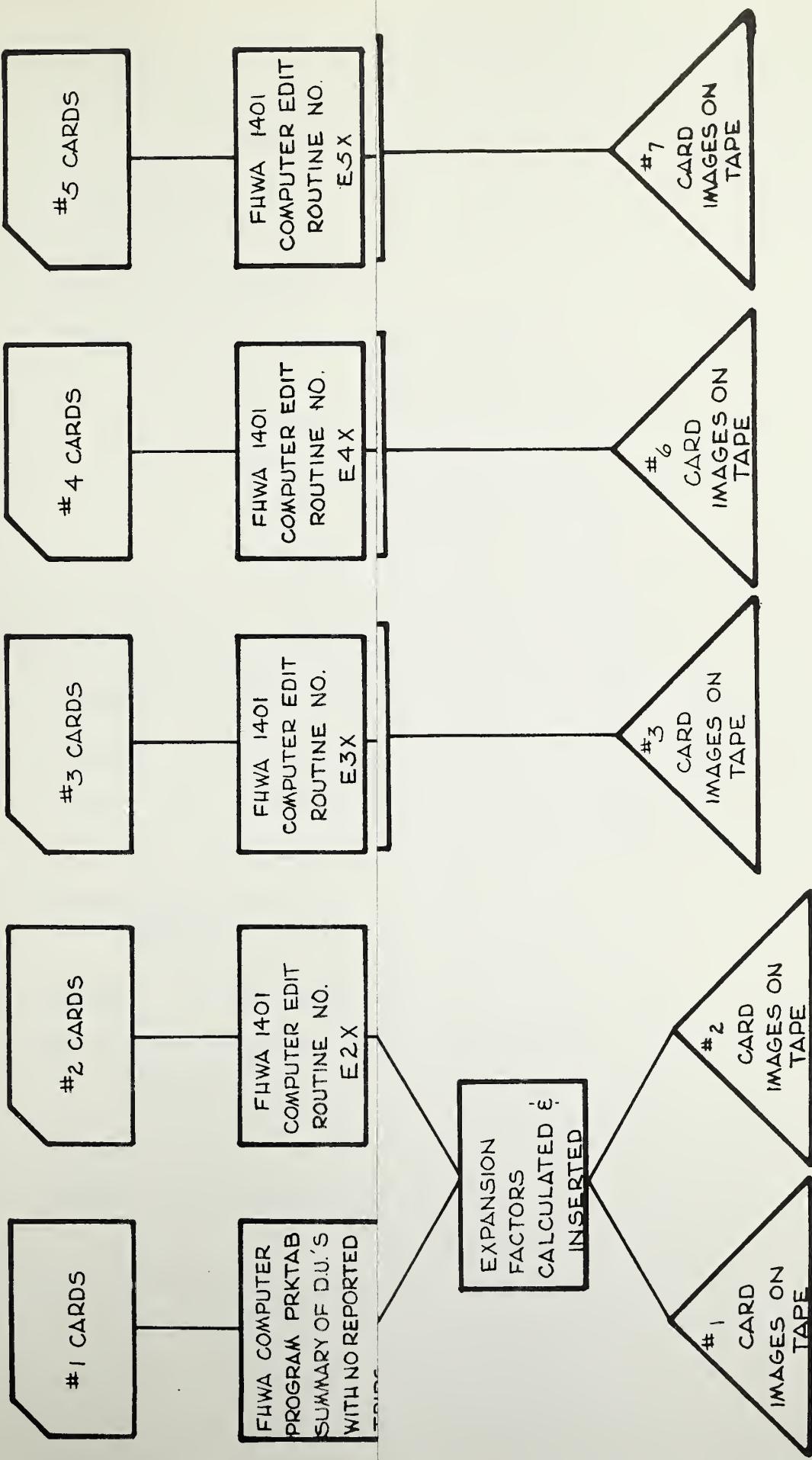


FIGURE IV-1

DATA EDIT FLOW CHART

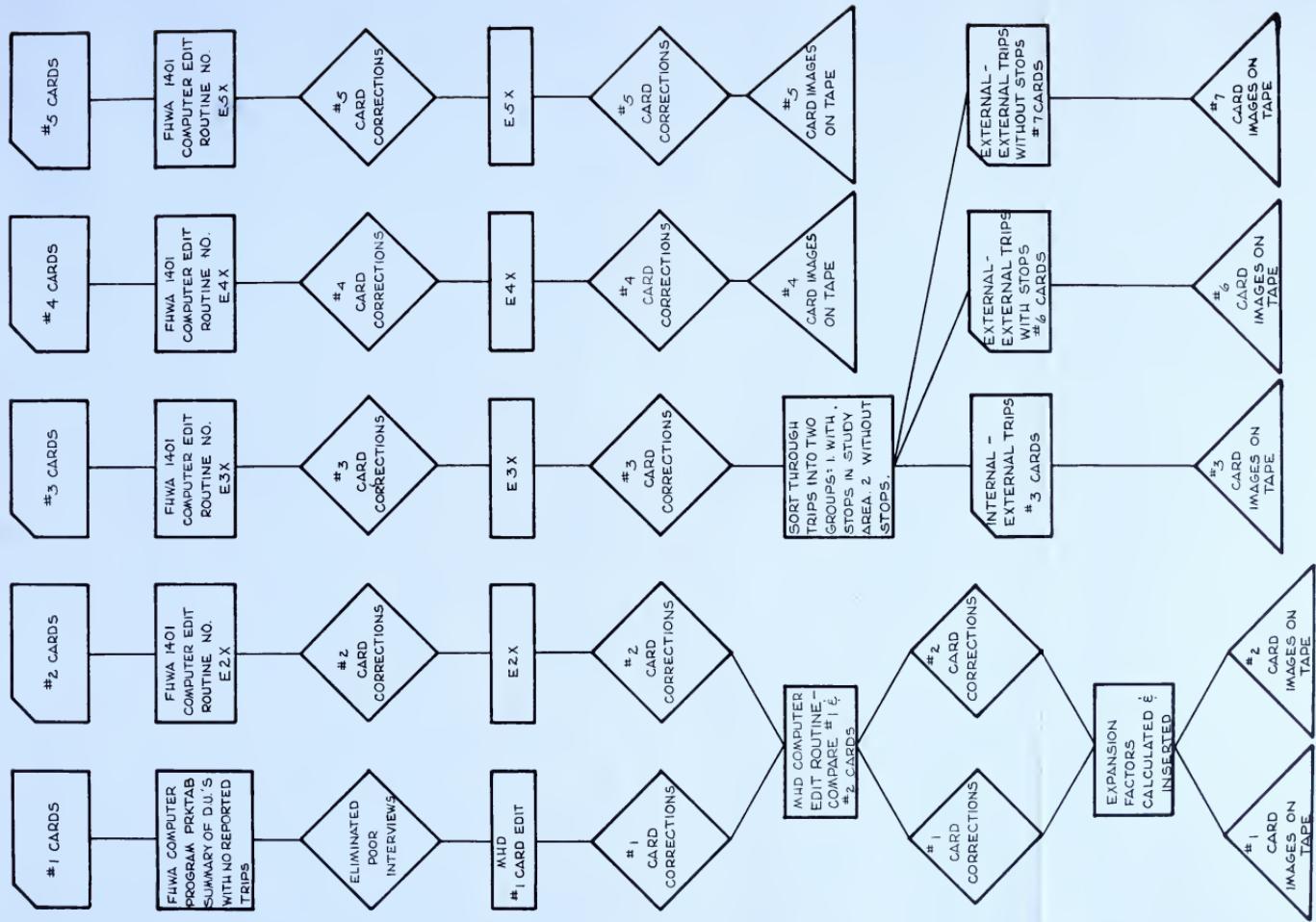


TABLE IV-1
SUMMARY OF DWELLING UNIT SAMPLES

Total Sample Numbers	2917	
Samples with reported trips	1626	55.7%
Samples without reported trips	<u>1291</u>	<u>43.3%</u>
Total	2917	100.0%

TABLE IV-2
SAMPLES WITH NO REPORTED TRIPS

Dwelling Unit Status	Number	Percent of Total
Vacant Dwelling Unit	205	15.9%
Vacant Lot - No structure	158	12.2
Initial Coding Errors	56	6.9
Incomplete Interviews	34	
Retired Occupants		
with cars	144	11.2
without cars	327	25.3
Commercial Establishments	10	0.8
Non-retired Occupants		
with cars	206	16.0
without cars	118	9.1
Refusal of Data	15	1.2
Montana Tech samples without trips	<u>18</u>	<u>1.4</u>
Total	1291	100.0%

18 Montana Tech samples. These appeared to be legitimate interviews with no trips reported.

In addition to the evaluation of the household characteristics of no trip samples, the location of each sample was plotted. It was found that 894 or 69.0 percent were located north of the Great Northern Railroad tracks and that 162 of these were located in the Central Business District. These figures include vacant dwelling units. This geographic distribution appears logical because many older, retired people live in this sector of town.

From the foregoing analysis, it was concluded that the high number of samples without reported trips is a valid characteristic of the Butte area and is not the result of under-reporting of trips.

The FHWA 1401 computer edit programs E2x, E3x, E4x, and E5x were used to check the travel survey data cards for errors. Table IV-3 is a tabular summary of the errors that were found as a result of the computer edits and the final number of acceptable samples for each travel survey. A total of 1956 errors were found using the edit programs; most of these were found to be coding errors. Examples of the more predominant errors are given in Table IV-3.

Two additional edits were performed on the #1 and #2 cards using edit programs developed by the Montana Department of Highways.

TABLE IV-3

SUMMARY OF EDIT CORRECTIONS

<u>Card Number*</u>	<u>Location</u>	<u>Sample Size</u>	<u>Number Original Data Cards</u>	<u>Number Edit Errors</u>	<u>Types of Errors</u>	<u>Number Accepted Samples After Corrections</u>
1	Dwelling Units	20%	2,917	489	Coding errors; examples include: 1) total no. persons not equal to separate listing, & 2) other carelessness.	2,655
2	All trips for 24 hr. period made from each of the above dwelling units	All trips from above 20% sample	11,000 (estimate)	1,188	Coding errors; examples include: 1) No #1 cards to match needed #2 cards, & vice versa 2) No. trips listed on #1 cards not equal #2 trip cards 3) #1 & #2 cards with non-matching home zones.	10,493
3	6 of 8 cordon stations	Variable**	7,000 (estimate)	34	Coding errors; examples include: 1) Incorrectly specified zone nos. 2) Invalid blanks; 3) Station nos. out of range.	6,080

continued on next page

TABLE IV-3 (continued)

SUMMARY OF EDIT CORRECTIONS

Card Number*	Location	Sample Size	Number Original Data Cards	Number Edit Errors	Number Accepted Samples After Corrections
					Types of Errors
4	Truck Trips	33%	1,500 (estimate)	240	Coding errors & types are: 1) time incorrectly coded 2) invalid blanks
5	Taxi Trips	100%	2,000 (estimate)	5	Coding errors: time incorrectly coded.
Total	-----	-----	24,417 (estimate)	1,956	21,782

* Each interview sheet is illustrated in the Appendix.

** Sample size depended upon number of vehicles that could be interviewed without serious traffic delays.

The first edit program cross-checked data on the #1 card. This check resulted in the discovery of 76 errors. The second program compared the number of trips reported on the #1 cards with the number of trips coded on the #2 cards. This check resulted in 298 errors.

This number of resulting edit errors is considered to be very high. The significance is that the corrections introduce a certain amount of judgement and interpretation into sample records. However, from observations in Chapter VII, it is concluded that data was not seriously effected by the large number of corrections.

Error edits and corrections were completed by the end of June, 1972.

CHAPTER V

TRAVEL DATA EXPANSION

TRAVEL DATA EXPANSION

DWELLING UNIT SAMPLES AND INTERNAL TRIP RECORDS

The dwelling unit sample was initially selected on the basis of twenty percent of the households in the study area. Theoretically, an expansion factor of 5.00 could be used to obtain the universe of 100%. During the survey, it was found that some samples were not valid. For example, it was found that 158 vacant lots and 10 commercial establishments were selected as samples. In addition, there were 34 incomplete interviews and 15 refusals during the interview survey. The expansion factors were adjusted to compensate for these invalid samples.

Chapter III outlines the method used to select the home interview sample. The sample source was the 1968 Land Use Inventory which was found to be outdated in 1970 due to the large number of demolitions as a result of the expansion of Berkley Pit. To check the validity of the 1968 Land Use Data, 1970 Census Data was used. In the older areas of the city, significant discrepancies were found between the 1968 Land Use Inventory and the 1970 Census. These discrepancies appeared to be due to demolition and renewal activities during the period from 1968 to 1970 when the home interview survey was conducted. Based on this analysis the 1970 Census Data was used to expand the home interview samples.

A separate expansion factor was developed for each traffic analysis zone. This calculation involved the comparison of the single and multiple dwelling units as obtained in the Census Data to those sampled in the home interview survey. For every zone where both types of units

were large enough to provide a reasonable comparison, separate factors were calculated for single family units and for multiple family structures. Zone 43, listed in Table V-1, illustrates the development of the two factors. However, if the sample of either single or multiple units per zone was too small to be representative, then all sampled units were combined together and compared to the sum of the single and the multiple units obtained in the Census. Zone 35 in the following table is an example of this case.

TABLE V-1
EXAMPLES OF DWELLING UNIT EXPANSION FACTORS

Zone	Single Units		Multiple Units		Expansion Factor		
	Sample	Census	Sample	Census	Single Units	Multiple Units	Combined
35	60	296	4	69	---	---	5.70
43	77	389	16	89	5.05	5.56	----

The above comparisons were carried out for each analysis zone. These factors were then coded onto the dwelling unit cards and the corresponding internal travel data cards (#2 cards).

It is noted that vacancies were retained in both the dwelling unit samples and the Census tabulations. After expansion of all samples, there were a total of 1,381 vacant dwelling units compared with 1,434 from the Silver Bow County 1970 Census listing. This comparison is shown in Table V-2.

TABLE V-2
 COMPARISON OF VACANT DWELLING UNITS
 SILVER BOW COUNTY vs. STUDY AREA

	<u>Total D.U.</u>	<u>Vacant D.U.</u>	<u>Percent Vacant</u>
Silver Bow County*	15,631	1,434	9.17
Transportation Study Area**	15,065	1,381	9.17

* Data from 1970 Census

** Data from expanded dwelling unit survey

Based on this comparison, the number of expanded vacancies in the study area is considered to be within reasonable accuracy.

EXTERNAL SURVEY

The guidelines as outlined in the "Manual of Procedures for Home Interview Traffic Study" were used to calculate expansion factors for the external interviews. The formula is as follows:

$$\text{Hourly Factor } F = \frac{S}{T} \times \left(\frac{V}{W} \times \frac{O}{P} \right)$$

where:

O = Actual number of vehicles (by vehicle type) counted during the hour of interview.

P = Number of completed interviews obtained for each vehicle type during the hour of interview.

V = Average automatic count for five days of all vehicles during the applicable hour.

W = Number of all vehicles counted during the applicable hour on the day of interview.

S = 24 hour average weekday traffic for five days for all vehicles.

T = 16 hour average count of all vehicles for five days.

The external travel survey interviewed only outbound traffic at the external stations. It was necessary to develop factors to expand those interviews to represent two-directional travel. During the survey 24 hour, directional, mechanical counts were taken at the external stations. Based upon these counts, expansion factors were calculated for the total volume of traffic through the station.

Through trips were separated into two groups:

1. trips entering and leaving the Study Area without an intermediate stop (card #6).
2. trips entering the Study Area with an intermediate stop before leaving (card #7).

The expansion at each station to represent two-directional traffic would incorrectly double the through trips. To account for this, the through trip expansion factors were halved.

TRUCK SURVEY

Chapter III outlined in detail the methods used in selecting the truck interview samples. A total of 341 samples were interviewed with a final total of 248 interviews completed.

Approximately 1,500 trip data cards were coded from the truck trip logs. Processing of these cards by the 1401 edit program, E4x, resulted in a final total of 873 valid trip cards.

Expansion factors were calculated based on a ratio of completed interviews to the total universe and on trips per interview. These factors were found to be 3.7 and 6.2, respectively. A preliminary check of truck crossings of the screenline indicated a deficiency of truck trips reported by the truck survey. An average expansion factor of 5.0 was applied with a supplemental screenline expansion factor to be applied after more detailed screenline accuracy checks. These checks are described in Chapter VII.

CHAPTER VI

1970 POPULATION AND EMPLOYMENT

1970 POPULATION AND EMPLOYMENT

The purpose of this chapter is to examine the sources of data available for arriving at the estimated 1970 population and employment for the Butte Urban Transportation Study area. There are three sources: the expanded home interview survey, the 1970 Census, and the 1968 Land Use Inventory. The first two are not independent because the survey samples were expanded using factors developed from the 1970 Census (as explained in the previous chapter). Comparisons of values from these three sources will be given along with the accepted base year figures.

1970 POPULATION

The home interview survey lists by zone the number of sample dwelling units and the sample population. It was necessary to expand both of these to represent the total universe for every zone in the study area. Dwelling unit expansion factors were developed based on 1970 dwelling unit Census data, and then applied to the zonal sample population. It was desirable to compare these resulting population figures against the 1970 Census tabulations.

Block statistics for the Butte urban area were available from the 1970 Census. To obtain the Census population for each traffic analysis zone, block data was aggregated. A direct comparison was possible for 96 zones while the remaining 19 zone boundaries did not coincide with the Census boundaries.

A zone by zone population comparison was made using the Census and the expanded survey figures. Although these two estimates were not totally independent because the internal trip expansion factors were based on the Census dwelling unit count, the comparison provides a check on population distribution by zone. Out of the 96 zones compared, all but six zones compared closely. Zones 24, 25, 49, 50, 53 and 54 had a total census population of nearly double that determined from the expanded home interview data. These zones are in the vicinity of Berkley Pit, an area which was undergoing substantial transition during the time differential between the Census data and the home interview data. These zones also constituted a very small portion of the total population. The overall comparison of expanded home interview population and Census population showed totals of 38,143 and 38,089, respectively. This was expected because the census dwelling unit counts were used to develop the initial expansion factors. The relatively close comparison of census and interview population by zone verifies the trip expansion factors. In the zones where the two sources showed substantial disagreement, the expanded home interview data was used.

For the nineteen zones for which the geographic zonal boundaries could not be directly compared to the Census boundaries, expansion factors were not available through use of Census data. Since the original sample size was twenty percent, the factors were expected to be about 5.00. Upon examination of aerial photographs, expansion factors of either 5.00 or 6.00 were chosen. With addition of these zonal totals to those given above, the expanded study area population for 1970 was 39,433. This figure is used as the 1970 population for this study.

The third source of population data available for comparison was the 1968 Land Use Inventory which estimated the existing population based on dwelling unit counts and projected future population to the year 1990. Table VI-1 shows a comparison of the area population from the three sources considered. It is seen that there is a considerable difference between the expanded home interview and Census populations and the 1968 Land Use Inventory population. Further examination was necessary to resolve this variation.

The 1968 population was estimated to be 45,400 for the Butte - Silver Bow Planning Area. This area does not correspond to the Transportation Study Area but the difference in the boundaries are in rural areas that should have very little effect upon the total population. (See Figure A-1 in Appendix A). One factor that caused a decrease in the area population between 1968 and 1970 was the Anaconda Company strike which caused a peak employment of nearly 20 percent.¹ During this period there was an out-migration of workers and their families. Due to this impact, the 1968 population estimate was not used to arrive at the base population for 1970.

¹ Population and Economic Inventory and Analysis - Howard, Needles, Tammen and Bergendoff: June, 1971, p. 14 - 15

TABLE VI-1
POPULATION COMPARISONS

Data Source	0-D Survey	1970 Census	0-D Survey	1968 ¹ Land Use Inventory	1970 Census
Area	BUTS Study (96 zones)	BUTS Study (96 zones)	BUTS Study Area (All 115 zones)	Planning Area	Silver Bow County
Year	1970	1970	1970	1968	1970
Population	38,143	38,089	39,433	45,400	41,981

¹ Land Use Plan; Howard, Needles, Tammen and Bergendoff; Butte - Silver Bow Land Use Data File; June, 1971 p. 6-11.

1970 EMPLOYMENT

Initially it was expected that the 1970 employment could be estimated from the 1968 Land Use Inventory. A tape containing the inventory was formatted to obtain the 1968 employment by traffic analysis zone. Total employment for the Transportation Study Area from this source was 16,374. The 1970 Census shows that 1970 employment for the entire county to be 14,703. Further checking of the 1968 employment distribution showed 3,811 employees or 23.3 percent of the total, employed at residential land uses. Three traffic analysis zones contained 2,645 of these employees. A check of land use in these zones revealed no places of employment capable of employing this number.

A third check of the 1968 land use inventory employment was made. Zonal totals were entered as variables into multiple regression equations to determine variable affecting trip generation. Normally, employment has a high correlation with work trip attraction. No such correlation was found, indicating either errors in the 1968 employment data or substantial changes in the number and distribution of employees between 1968 and 1970.

Because of the foregoing inconsistencies, an independent determination of employment was obtained using a combination of 9,119 employees listed by the Montana State Employment Security Division and phone contact with employers not covered under unemployment compensation. The employment in the Butte Transportation Study Area was determined to be 13,488, for the period when the home interview survey was conducted.

In summary, the following base figures will be used for the 1970 Transportation Study Area population and employment:

1970 Population = 39,433

1970 Employment = 13,488

CHAPTER VII

TRAVEL DATA ACCURACY CHECKS

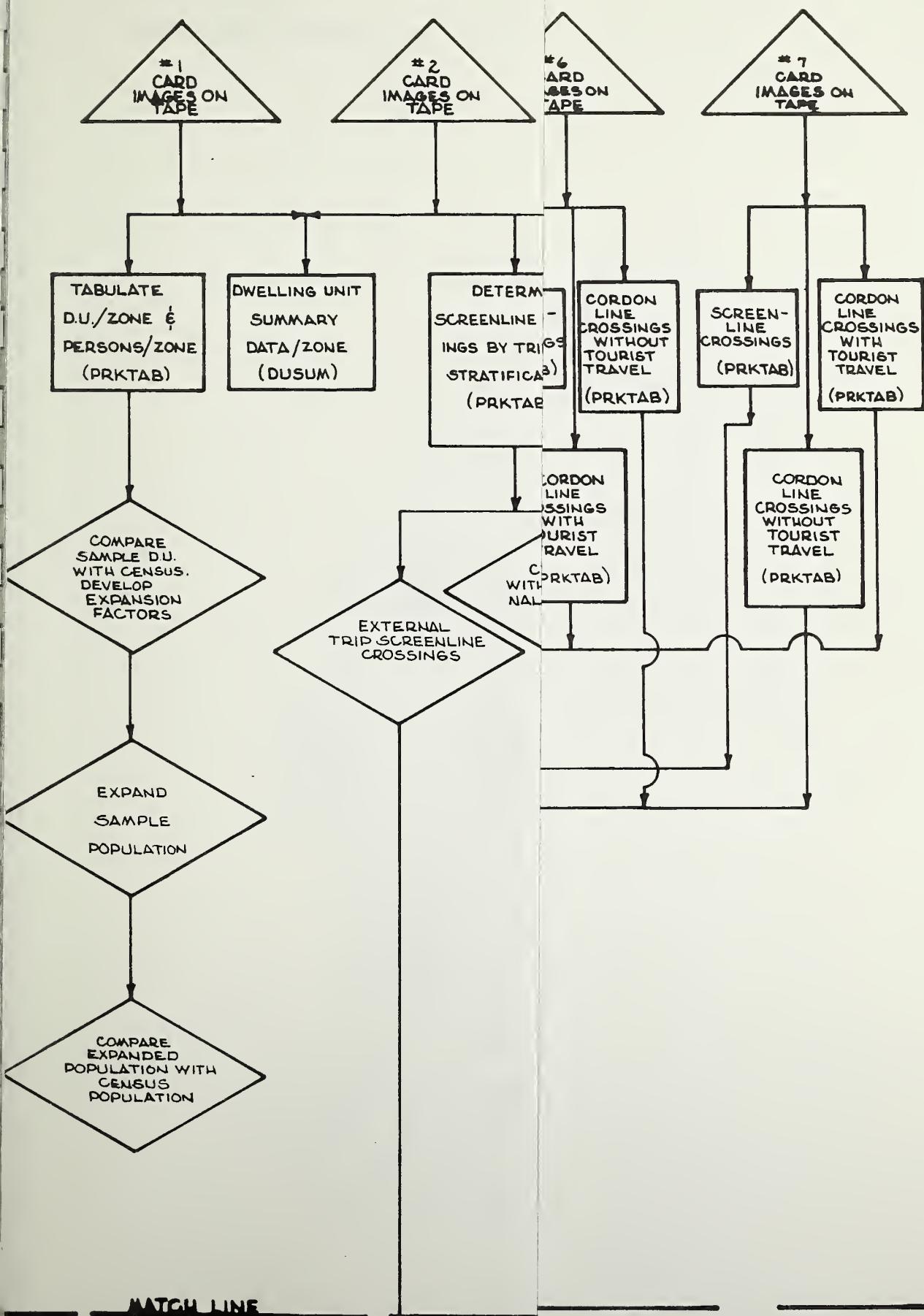
TRAVEL DATA ACCURACY CHECKS

GENERAL

Prior to travel survey data collection, a screenline was established. The purpose of a screenline is to provide a line along which vehicle counts can be taken during the travel surveys for comparison with the expanded travel survey data. This comparison of actual traffic counts with trip data obtained from the interview surveys, provides a check of the accuracy of the interviews. If the comparison is less than 85 percent, adjustments are made to the travel data to obtain a closer correlation to the actual traffic counts. The Butte Urban Transportation Study screenline was established, generally along the Great Northern Railroad tracks (See Figure A-3, Appendix). This alignment provides a screenline with a minimum of vehicular crossings, which bisects the study area and which separates the central business district from the expanding commercial, industrial and residential areas to the south.

Figure VII-1 is a flow chart of the travel survey accuracy checks. The traffic analysis zones and external stations were separated into two groups depending upon whether they were north or south of the screenline. Computer summaries by hour were obtained of all trip interchanges between the two groups. These hourly totals from the expanded survey were compared to the 16 hour manual and machine counts taken at the screenline crossings.

FIGURE VII-1



TRAVEL DATA ACCURACY CHECK FLOW CHART

FIGURE VII-1

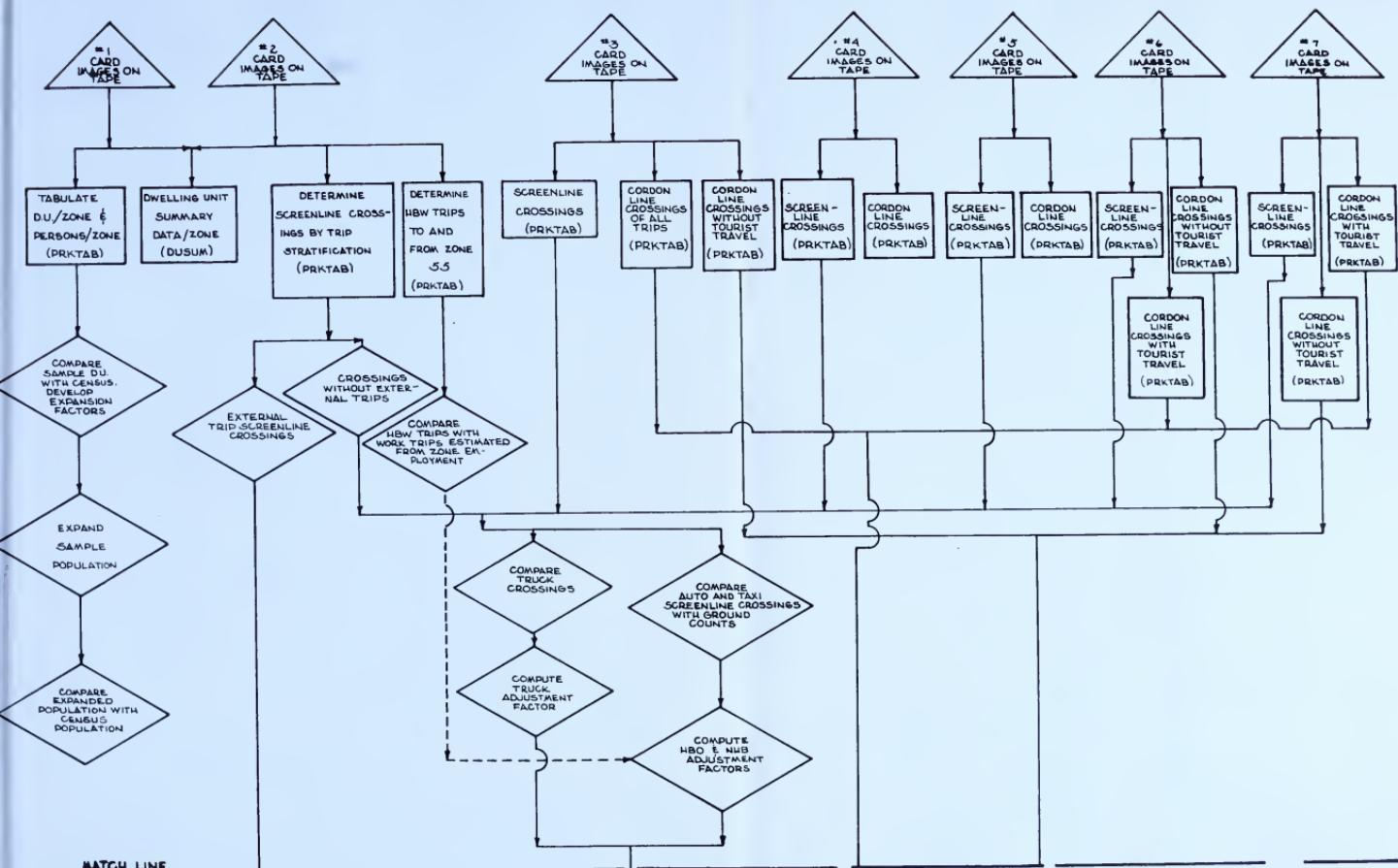


FIGURE VII-1 (Cont'd)

MATCH LINE

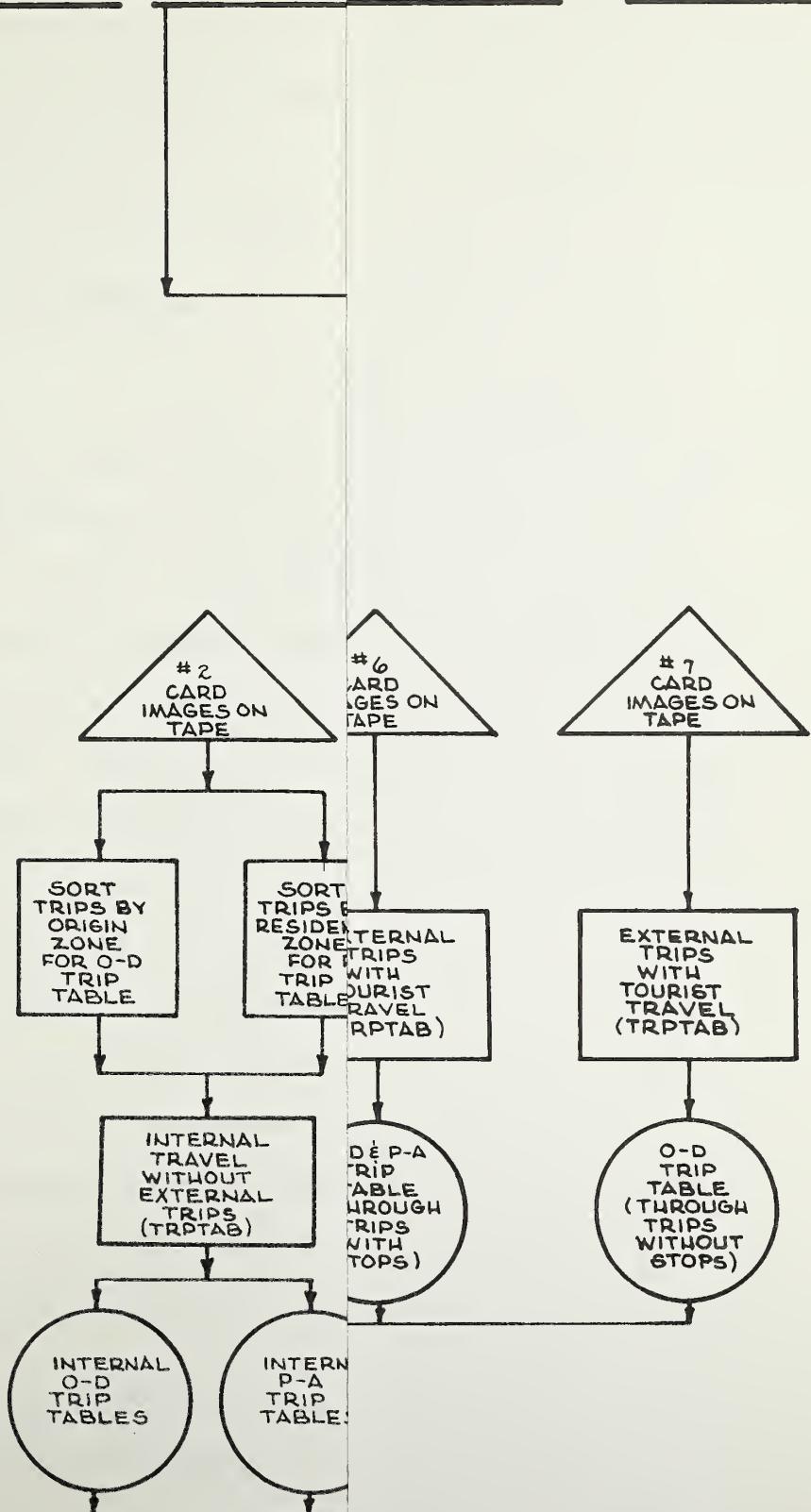
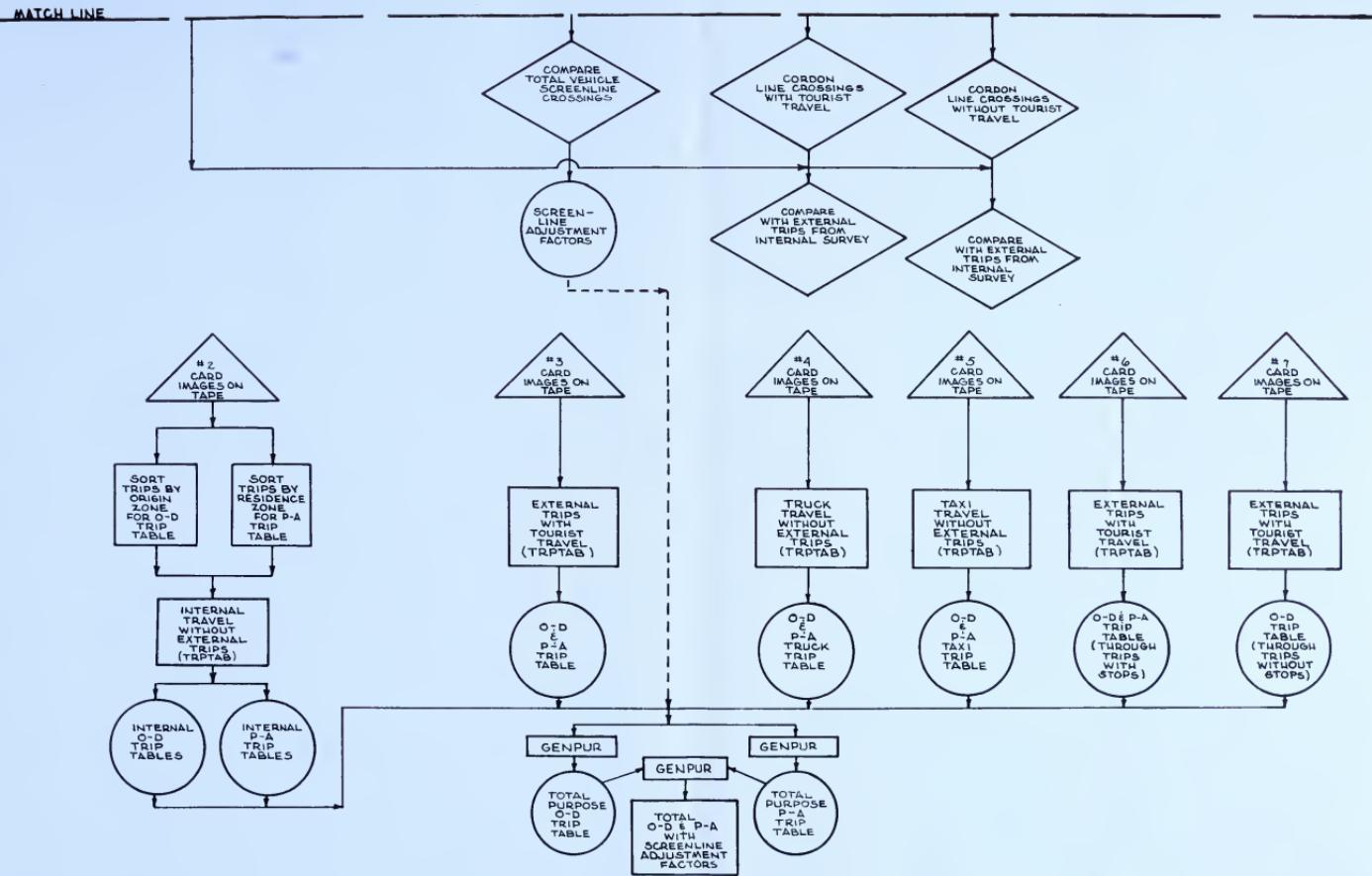


FIGURE VII-1 (Cont'd)



Screenline comparisons were made for three types of vehicular crossings:

1. autos plus taxis
2. trucks
3. total vehicles

SCREENLINE COMPARISONS

General

Manual counts were taken at the screenline crossings for a 16 hour period beginning at 6 a.m. and ending at 10 p.m. Comparison of trips by vehicle type is only possible for this period. Mechanical counts were taken for a 24 hour period, so it is possible to determine the hourly totals of vehicles crossing the screenline for the 8 hour period from 10 p.m. to 6 a.m. At the outset of the accuracy checks it was determined that 9.4 percent of the screenline crossings occurred between 10 p.m. and 6 a.m. It was also determined that under-reporting of trips in the interview surveys was very high for this period, with 28 percent of the trips recorded. Under-reporting during this time period is not unusual because travel is not usually a regularly scheduled trip and is often not remembered by the driver. Because of the high under-reporting, home-based other and non-home based trips for the 16 hour period were expanded to equal the 24 hour total. Truck, taxi and home-based work trips were expanded over the entire 24 hour period.

The travel survey data was determined to be 72.1 percent of the actual screenline crossings for the 16 hour period from 6 a.m. to 10 p.m.

A comparison of 85 percent is the minimum acceptable accuracy and a 97 percent comparison is desirable. It was therefore necessary to adjust the travel survey data to more closely correspond to the screenline counts.

Screenline Adjustment Factors

A series of check and trial adjustments were carried out to determine the most logical way to adjust the travel survey data to correspond to the actual count data.

The methods used are described below:

1. Due to the possibility of multiple screenline crossings along I-90 and I-15, an analysis of the effect on the survey - ground count screenline crossing comparison was carried out. Three possible movements were considered:
 - a. Enter study area via I-90 - I-15 from the west and exit freeway onto Montana Avenue northbound (and vice-versa).
 - b. Proceed through study area via the interstate routes from the west to the northeast (and vice-versa).
 - c. Enter study area from northeast via I-15 and exit freeway to either Harrison Avenue or Montana Avenue and proceed north to cross screenline.

The first possibility was examined using ramp traffic counts. During the survey period, the on/off ramps to the west carried 1,350 vehicles per day. Of these vehicles, 53.8% or 725 utilized Montana Avenue north of the interchange

which resulted in 725 multiple crossings. Adjustment of screenline ground counts to account for these crossings resulted in an average 16 hour deviation between the adjusted survey data and actual ground counts of 0.02 percent. This adjustment was insignificant.

The average daily traffic on IR-15 east of Butte was 525 during the travel survey period. Effects due to multiple crossings were insignificant.

Due to a longer travel time by way of the multiple crossing route, the third type of multiple crossings would result primarily when tourist travel was high and motorists were not familiar with local traffic patterns. Since the internal travel surveys were taken in the fall, tourist travel was low and resulting multiple crossings were considered negligible.

2. A 24 hour factor for all internal survey trips was calculated by comparing them with the actual ground counts. It was found to be 1.591. That adjustment, when applied to the internal trips, increased the total number of travel survey trips to within acceptable limits; however, the variation between the actual ground counts and the adjusted survey trips during the morning and afternoon peak hours was 43.0 percent and 11.0 percent, respectively. Other time periods also exhibited considerable variation. This was not considered to be sufficiently accurate.

3. The failure of an overall adjustment factor to bring the interview data into acceptable accuracy limits led to examination of the various trip purposes to determine if separate adjustment factors would result in a closer correlation of the screenline crossing comparison. Home-based work trips were checked first to determine if there was under-reporting. Normally these are the most accurately reported trips. Figure VII-2 (page VII-14) shows the morning and evening HBW trip peaks. It can be seen that both peaks are very well defined and even though the afternoon peak is not as high as in the morning, it is of longer duration as would be expected. The shape of that curve lends confidence to the accuracy of the HBW trips, and suggests that they should not be adjusted.

One further check on work trips was made. The traffic analysis zone (zone #55) containing the Anaconda Company concentrator was used to evaluate the accuracy of work trip reporting. The number of work trips into and out of zone 55 were compared to the total trips estimated from the total employment in the zone. The only activity in zone 55 is the Anaconda Company concentrator and at the time of the travel surveys, employment was 135. Two regular work trips were assumed per employee each day, making a total of 270 trips. The number of survey work trips amounted to 308, but 29 of these were found to be

scattered randomly throughout the day indicating that they were probably non-home based. These were subtracted, giving 279 regular work trips from the expanded survey work trip files. The results of this evaluation are shown in Table VII-1.

TABLE VII-1
HOME - BASED WORK TRIP COMPARISON

Zone No.	Industry	Number Employees ¹	Estimated Regular Employee Work Trips	O - D Survey Work Trips	Adjusted ² O - D Work Trips	Percent Deviation
55	Anaconda Company Concentrator	135	270	308	279	+3.3%

¹ Estimated October to November 1970 Employment; Source: City of Butte Employment Service

² Twenty-nine (29) work trips made at irregular periods of the day were subtracted.

This close comparison coupled with the reasonable comparison of reported peak hour work trips to screenline ground counts indicates a high level of work trip reporting in the home interview survey.

4. At this point it was concluded that the screenline ground counts and the HBW trips were sufficiently accurate that no adjustment would be required. Taxi screenline crossings

were not of a magnitude capable of significantly affecting the screenline comparison. Truck trips will be considered separately in a subsequent section, and external survey trips are assumed to be accurately reported because they are a direct interview of the particular trip.

The remaining trips were the home-based other (HBO) and non-home based (NHB) trips from the home interview survey. It was not possible to determine which of these trip types was under-reported since no interviews were conducted at the screenline crossings. A series of iterations were carried out to determine a combination of adjustment factors for both trip types that would result in a minimum total deviation. Table VII-2 shows the calculated adjustment factors. The limits of Table VII-2 were established by applying the entire adjustment to the HBO trips at one extreme and to the NHB trips at the other. The minimum average deviation within these limits was found to be 6.25% for HBO and NHB trip adjustment factors of 2.0 and 1.3, respectively. Carried to the hundredths place these are 1.98 and 1.38 for an average deviation of 6.24%.

TABLE VII-2
DETERMINATION OF HBO AND NHB
16 HOUR SCREENLINE ADJUSTMENT FACTORS

HBO Factor	NHB Factor	Average % Deviation	Remarks
1.0	2.8	Not calculated	100% of adjustment applied to NHB trips.
1.2	2.5	11.14	-----
1.4	2.2	9.47	-----
1.6	1.4	7.96	-----
1.8	1.6	6.49	-----
2.0	1.3	6.25	Minimum
2.2	1.0	6.95	100% of adjustment applied to HBO trips.

Because of the high rate of under-reporting from midnight to 6 a.m. (28 percent of trips reported), the 16 hour expanded HBO and NHB trips were further expanded to equal the 24 hour total. The 16 to 24 hour factor for both trip types was 1.11 making the combination adjustment factors 2.20 and 1.53 for HBO and NHB, respectively.

5. Since classification counts were made at the screenline crossings for 16 hours, it was possible to compare trips reported in the truck survey with the actual number of truck crossings. Table VII-7 (page VII-20) indicates that the number of trucks crossing the screenline was only 3.96 percent of the total vehicle crossings; hence,

only one 24 hour factor of 1.26 was developed.

Table VII-3 summarizes the screenline adjustment factors as applied to the 1970 Origin and Destination trips for the Butte Urban Transportation Study.

TABLE VII-3
SCREENLINE ADJUSTMENT FACTORS

Trip Type	<u>16 Hour Factor 6 a.m. to 10 p.m.</u>	<u>16 to 24 Hour Factor</u>	<u>Combination 24 Hour Factor¹</u>
HBW	1.00	1.00	1.00
HBO	1.98	1.11	2.20
NHB	1.38	1.11	1.53
Truck	1.00	1.00	1.26
Taxi	1.00	1.00	1.00
External	1.00	1.00	1.00

¹ The Combination 24 Hour Factor is obtained by multiplying the 16 hour factor times the 16 to 24 hour factor.

Auto - Taxi

The hourly accumulation of all autos and taxis crossing the screenline was obtained from the internal, external and taxi surveys. The internal trips were separated into home-based work (HBW), home-based other (HBO) and non-home based (NHB) so that each could be plotted by hour period for examination. Internal/external trips were totaled from the external survey. Table VII-4 is a tabular summary of the comparison

of auto and taxi screenline crossings and similar trips from the travel surveys. Figure VII-2 is a graphical comparison of Table VII-4.

Figure VII-2 shows that the expanded auto - taxi travel survey data is consistently lower than the actual ground counts, for every hour of the day.

Taxi trips are fairly constant for the entire day and are of such low volume that they have little effect on the total vehicular volume.

HBW trips exhibit the highest peak hour volumes from the internal survey and these peaks are consistent with the screenline crossing. These trips are usually well reported because they are made at the same time, several times a week.

HBO trips show the same general trends as the screenline counts, but do not have the characteristic work trip peaks.

The external trips are evenly distributed throughout the 16 hour period.

The combination of all auto and taxi trips before adjustment is 71.4 percent of the same type trips that were crossing the screenline during the travel surveys. After the screenline adjustments, the travel survey data represents nearly 100 percent of the actual screenline crossings.

TABLE VII-4

AUTO PLUS TAXI SCREENLINE CROSSINGS

Hour	Taxi	HBM	HBO	NHB	Exter- nal	Total	Adjusted Total	Actual Ground Total	Difference	Percent
6-7	16	206	64	6	142	434	499	454	45	9.91
7-8	17	1,480	495	127	291	2,410	2,943	2,652	291	10.97
8-9	25	812	561	320	330	2,048	2,721	2,605	116	4.45
9-10	28	185	389	229	373	1,204	1,672	1,764	-92	-5.21
10-11	25	97	442	326	395	1,285	1,842	1,810	32	1.76
11-12	40	122	517	577	534	1,790	2,516	2,384	132	5.53
12-13	41	297	450	1,030	438	2,256	3,088	3,123	-35	-1.12
13-14	32	104	733	687	411	1,967	2,946	2,778	168	6.05
14-15	24	233	702	582	455	1,996	2,905	2,906	-1	-0.03
15-16	23	421	826	714	454	2,438	3,518	3,626	-108	-2.97
16-17	27	947	846	650	522	2,992	4,066	3,988	78	1.95
17-18	30	1,037	930	307	441	2,745	3,773	3,681	92	2.50
18-19	24	303	571	204	442	1,544	2,182	2,378	-196	-8.24
19-20	23	104	776	188	395	1,486	2,317	2,248	69	3.07
20-21	18	50	481	124	396	1,069	1,586	1,806	-220	-12.18
21-22	10	72	386	98	151	717	1,121	1,473	-352	-23.90
TOTAL	403	6,470	9,169	6,169	6,170	28,381	39,695	39,676	+19	+ 0.05

JTO - TAXI SCREENLINE
ACCURACY CHECK

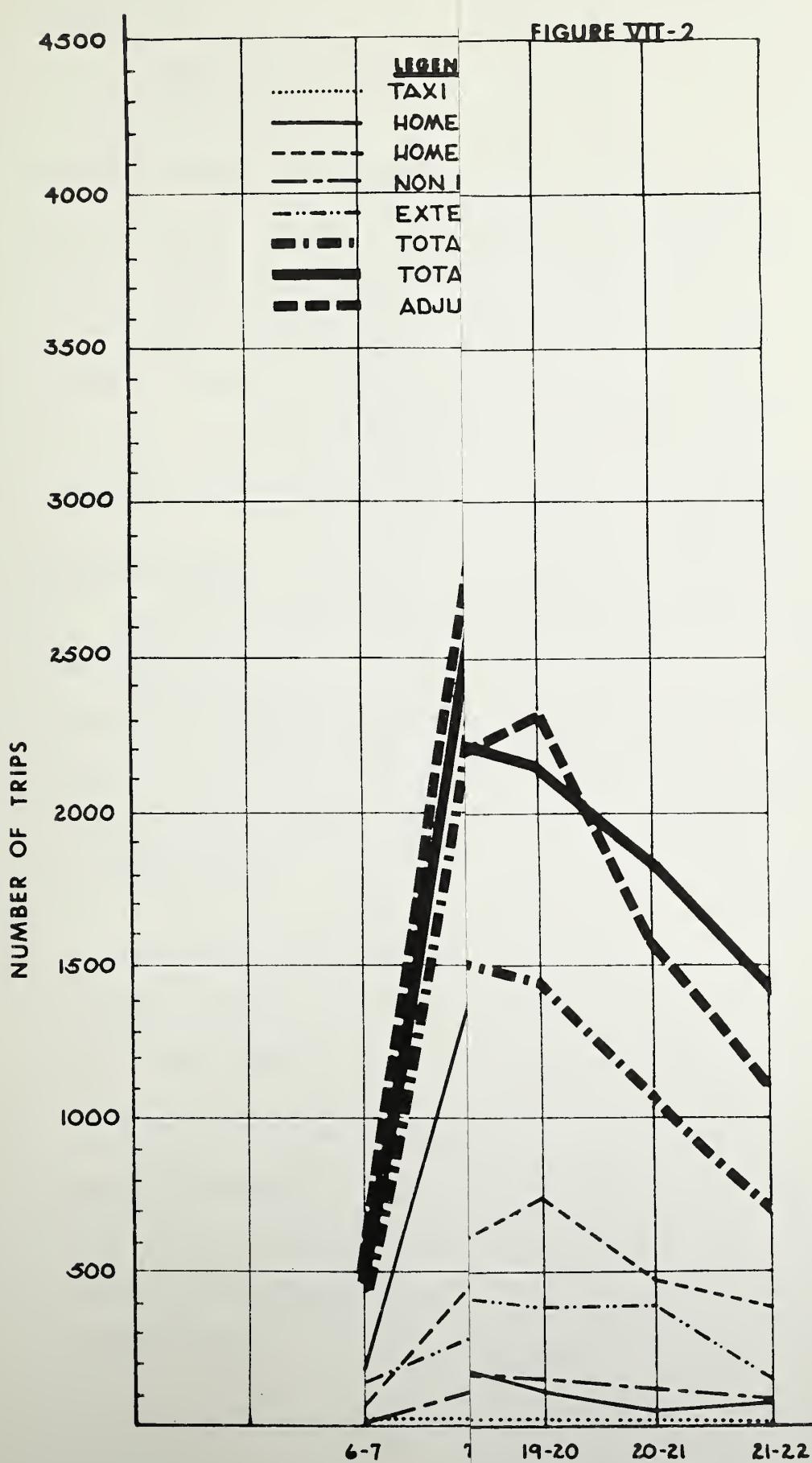
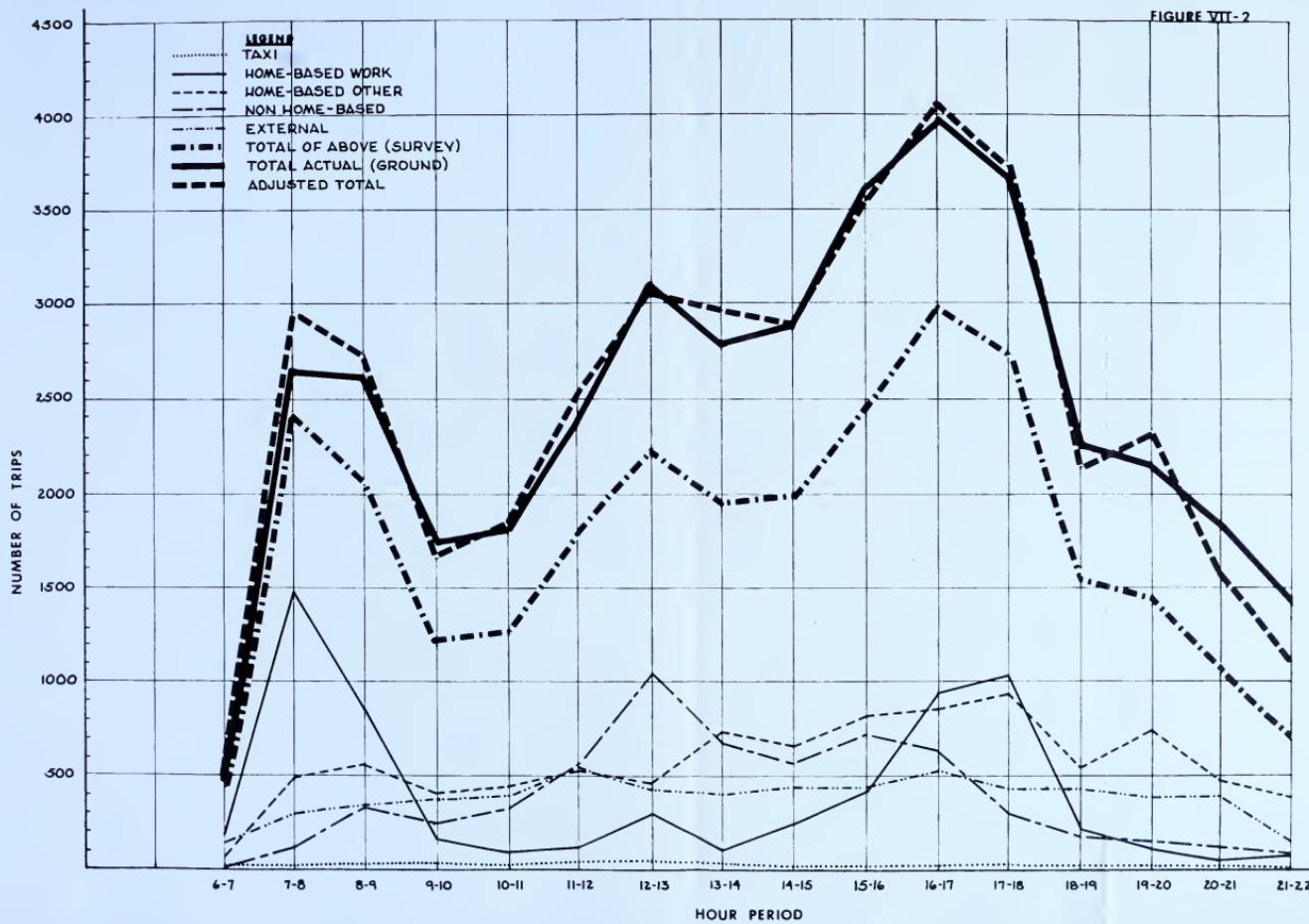


FIGURE VII-2



Trucks

A separate screenline comparison was made to determine the accuracy of the truck survey data. Table VII-5 and Figure VII-3 are tabular and graphical comparisons of the truck survey screenline crossings and the actual vehicular counts of trucks crossing the screenline. The total trucks crossing the screenline as determined by the travel survey is consistently low when compared to total truck screenline crossings. There is a particular drop in the travel survey crossings from 2 p.m. to 3 p.m. This drop amounts to 68 truck trips which is not significant in terms of total vehicles crossing the screenline (45,585 trips).

Total Vehicles

Table VII-6 and Figure VII-4 represent hourly comparisons between the total vehicles crossing the screenline as determined from actual counts and the expanded and adjusted travel survey trips. They were compiled through a combination of auto plus taxi trips, as shown in Table VII-4 and Figure VII-2, and truck trips, shown in Table VII-5 and Figure VII-3.

After expansion of each trip type and application of the screenline adjustment factors, the travel survey data represents nearly 100 percent of the ground counts.

Table VII-7 shows the total number of trips crossing the Butte Study Area screenline. It is noted that after final adjustments, 45,585 or 41.8 percent of the interzonal trips crossed the screenline during the travel survey period. This is considered to be a good representative of total travel.

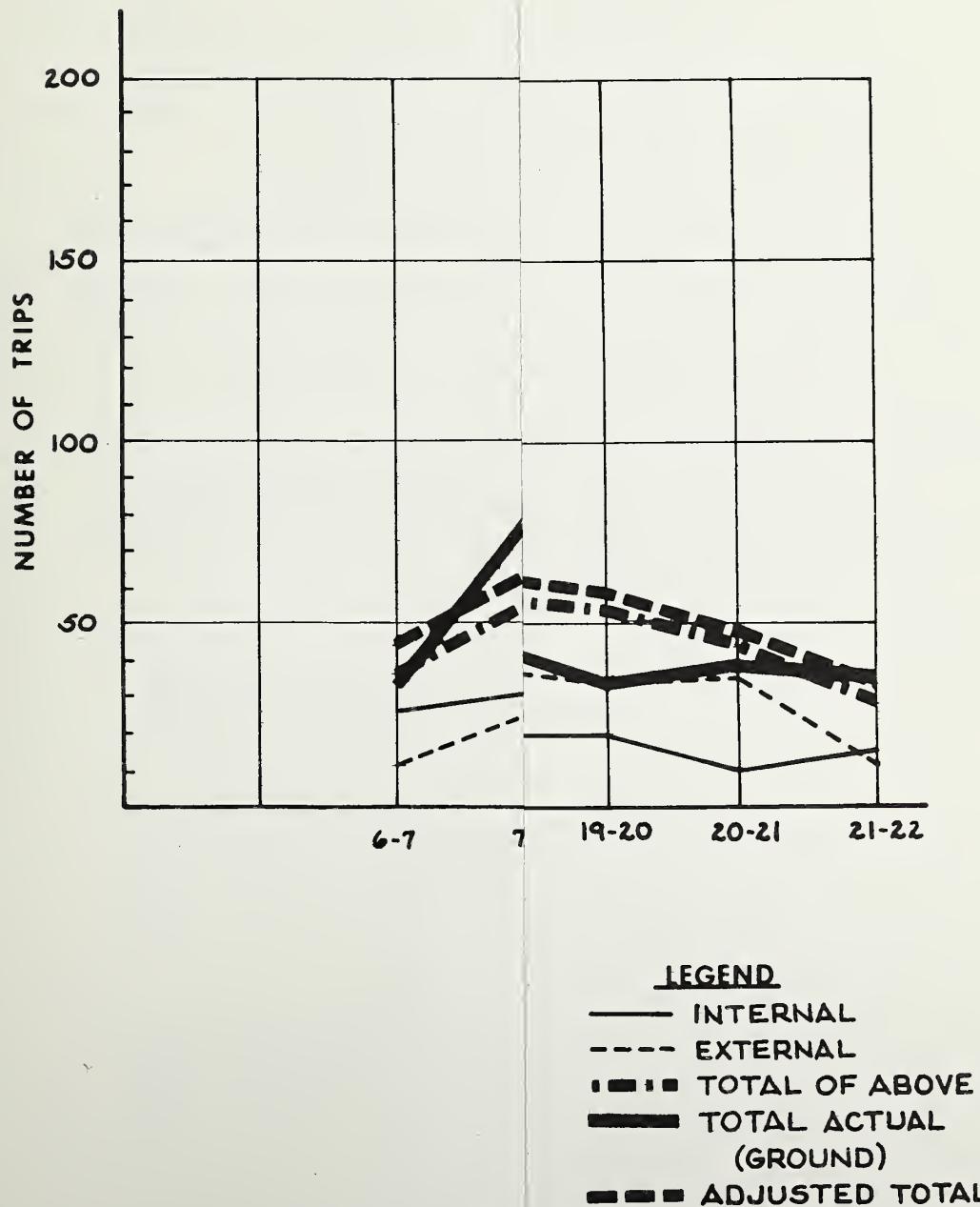
TABLE VII-5

TRUCK SCREENLINE CROSSINGS

<u>Hour</u>	<u>Internal</u>	<u>External</u>	<u>Total</u>	<u>Adjusted Total</u>	<u>Screenline Total</u>	<u>Difference</u>	<u>Percent Deviation</u>
6-7	25	12	37	44	36	+ 8	+22.2
7-8	30	25	55	63	81	-18	-22.2
8-9	80	28	108	129	153	-24	-15.7
9-10	95	32	127	152	157	- 5	- 3.2
10-11	80	34	114	135	131	+ 4	+ 3.1
11-12	75	45	120	140	157	-17	-10.8
12-13	65	56	121	138	132	+ 6	+ 4.5
13-14	95	35	130	155	136	+19	+14.0
14-15	55	38	93	107	175	-68	-38.9
15-16	105	39	144	172	163	+ 9	+ 5.5
16-17	105	44	149	177	141	+36	+25.5
17-18	35	37	72	81	81	0	0.0
18-19	20	38	58	63	48	+15	+31.3
19-20	20	33	53	58	33	+25	+75.8
20-21	10	34	44	47	36	+11	+30.6
21-22	15	13	28	32	32	0	0.0
TOTAL	910	543	1453	1693	1692	+ 1	0.0

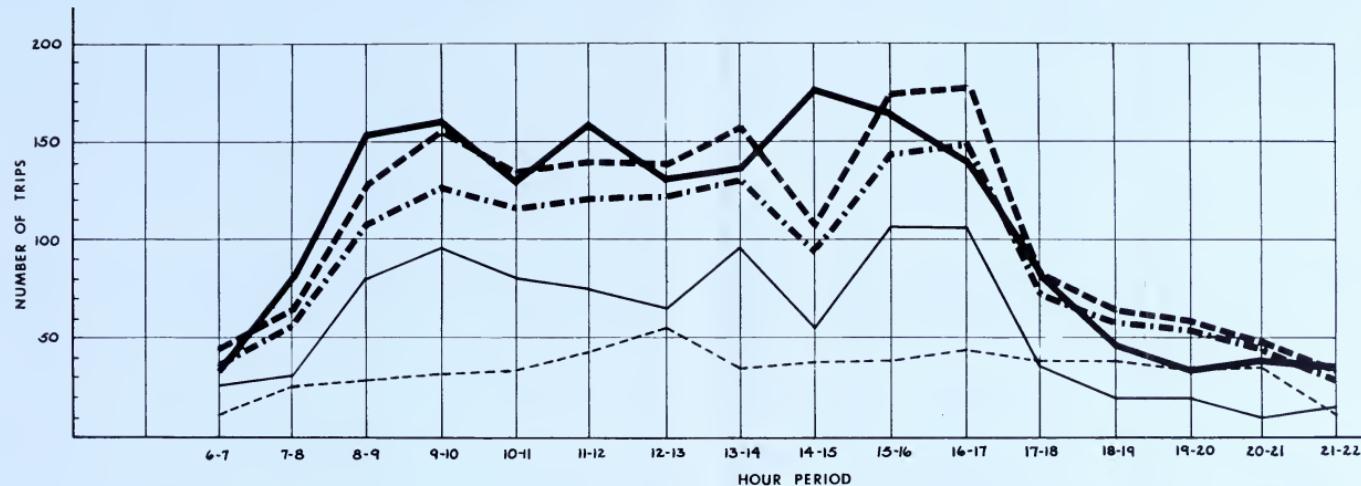
TRUCK SCREENLINE
ACCURACY CHECK

FIGURE VII-3



TRUCK SCREENLINE
ACCURACY CHECK

FIGURE VII-3



LEGEND.

- INTERNAL
- - EXTERNAL
- · · TOTAL OF ABOVE
- ■ ■ TOTAL ACTUAL (GROUND)
- · — ADJUSTED TOTAL

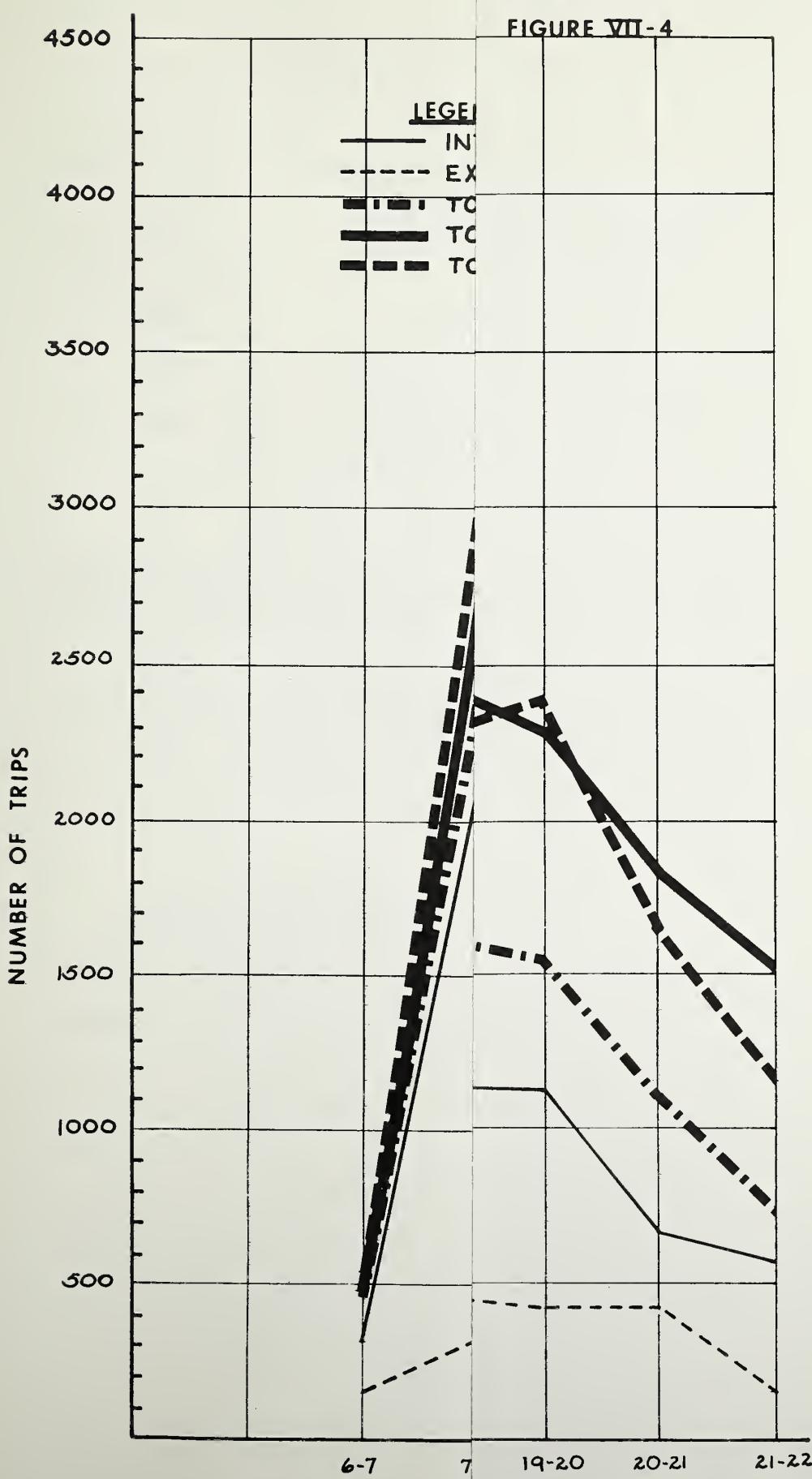
TABLE VII-6

TOTAL VEHICLE SCREENLINE CROSSINGS

<u>Hour</u>	<u>Internal</u>	<u>External</u>	<u>Total</u>	<u>Adjusted Total</u>	<u>Screenline Total</u>	<u>Difference</u>	<u>Percent Deviation</u>
6-7	317	154	471	543	490	+ 53	+10.81
7-8	2,149	316	2,465	3,006	2,733	+273	+ 9.98
8-9	1,798	358	2,156	2,850	2,758	+ 92	+ 3.33
9-10	926	405	1,331	1,824	1,921	- 97	- 5.05
10-11	970	429	1,399	1,977	1,941	+ 36	+ 1.85
11-12	1,331	579	1,910	2,656	2,541	+115	+ 4.52
12-13	1,883	494	2,377	3,226	3,255	- 29	- 0.89
13-14	1,651	446	2,097	3,101	2,914	+187	+ 6.41
14-15	1,596	493	2,089	3,012	3,081	+ 69	+ 2.24
15-16	2,089	493	2,582	3,690	3,789	- 99	- 2.61
16-17	2,575	566	3,141	4,243	4,129	+114	+ 2.76
17-18	2,339	478	2,817	3,854	3,762	+ 92	+ 2.44
18-19	1,122	480	1,602	2,245	2,426	-181	- 7.46
19-20	1,111	428	1,539	2,375	2,281	+ 94	+ 4.12
20-21	683	430	1,113	1,633	1,842	-209	-11.34
21-22	581	164	745	1,153	1,505	-352	-23.38
TOTAL	23,121	6,713	29,834	41,388	41,368	+ 20	+ 0.05

**TOTAL VEHICLE
SCREENLINE
ACCURACY CHECK**

FIGURE VII-4



TOTAL VEHICLE
SCREENLINE
ACCURACY CHECK

FIGURE VII-4

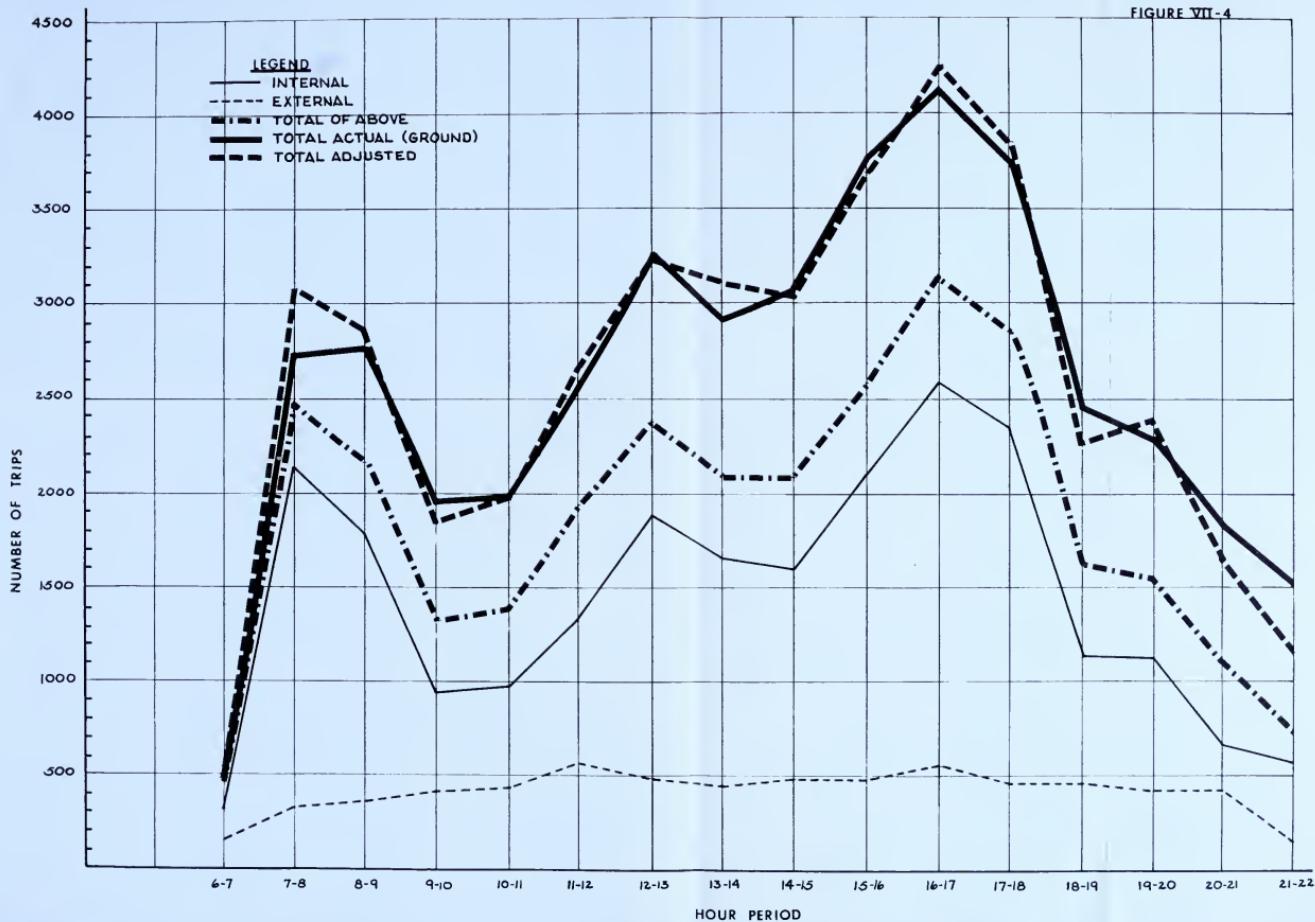


TABLE VII-7
ORIGIN - DESTINATION TRAVEL SURVEY
SCREENLINE CROSSINGS

Trip	Number of Trips		
	Unadjusted (16 hours)	Adjusted (16 hours)	Adjusted (24 hours)
Internal Survey			
HBW	6,470	6,470	6,874
HBO	9,169	18,144	20,140
NHB	6,169	8,508	9,444
Truck	910	1,150	1,194
Taxi	403	403	438
External Survey			
Auto + Taxi	6,170	6,170	6,886
Truck	543	543	609
Total	29,834	41,388	45,585

Table VII-8 shows the final adjusted trips from the Origin - Destination travel surveys. A total of 107,880 trips were made by area residents, resulting in an average of 7.88 trips per household.

TABLE VII-8

ORIGIN - DESTINATION TRAVEL SURVEY TRIPS
(24 Hours)

Trip Purpose	NUMBER OF TRIPS			Percent (%)		
	Unadjusted	Adjusted	Between Zones	Intra-Zonal	Total	
Internal Survey						
HBM	13,566	218	13,348	218	13,566	12.1
HBO	25,740	831	51,160	1,829	52,989	47.2
NHB	16,971	538	24,298	804	25,102	22.3
Truck	3,585	365	4,511	462	4,973	4.4
Taxi	1,629	47	1,629	47	1,676	1.5
External Survey						
Int. - Ext.	3,436*	—	—	—	4,787	4.3
Ext. - Int.	3,436*	—	—	—	4,787	4.3
Through (with stops)	263*	—	—	844	—	—
Through (without stops)	2,379*	—	3,573	—	3,573	3.2
TOTAL	71,005	1,999	108,937	3,360	112,297	100.0

* 16 hours

CORDON LINE COMPARISON

Internal/external trips were interviewed in both the internal survey and the external survey, making it possible to cross-check the two surveys.

This check was carried out and is shown in tabular form in Table VII-9 and graphically in Figure VII-5. The initial comparison shows a substantial variation between the two surveys. This is due to the seasonal variations of travel. The external survey was conducted in August which is the peak of tourist travel, while the internal survey was made in November and December when there is very little tourist travel. To compensate for this seasonal variation, all auto trips made by out-of-state vehicles were removed from the external trips. The result was a very close comparison at the morning and evening peaks with larger deviations during the offpeak hours. These can be attributed to the seasonal variation of local traffic.

TABLE VII-9

CORDON LINE CROSSINGS

Hour	Internal Survey Auto	Internal Survey Truck + Taxi	Internal Survey Total	Adjusted Internal Survey (ext. trips)		External Survey Total	(all vehicles)	Difference	Percent Deviation
				Internal Survey	External Survey				
6-7	76.59	20.00	96.59	129.00	173.00	- 44	+ 25.40		
7-8	273.60	20.00	293.60	309.00	206.00	+ 3	+ 0.98		
8-9	64.91	60.00	124.91	150.00	302.00	-152	- 50.30		
9-10	94.92	20.00	114.92	160.00	292.00	-132	- 45.20		
10-11	77.42	30.00	107.42	149.00	325.00	-176	- 54.10		
11-12	74.67	30.00	104.67	149.00	290.00	-141	- 48.60		
12-13	51.67	20.00	71.67	119.00	217.00	- 98	- 45.20		
13-14	104.50	30.00	134.50	230.00	353.00	-123	- 34.80		
14-15	108.55	40.00	148.55	249.00	358.00	-109	- 30.50		
15-16	166.96	40.00	206.96	353.00	354.00	- 1	- 0.28		
16-17	290.79	50.00	340.79	442.00	430.00	+ 12	+ 2.79		
17-18	145.93	20.00	165.93	254.00	371.00	-117	- 31.50		
18-19	116.53	20.00	136.53	203.00	375.00	-172	- 45.80		
19-20	63.59	20.00	83.59	136.00	396.00	-260	- 65.60		
20-21	26.58	10.00	36.58	60.00	323.00	-263	- 81.30		
21-22	26.11	10.00	36.11	58.00	6.00	+ 52	+867.10		
TOTAL	1763.32	440.00	2203.32	3150.00	4871.00	-1721	- 35.30		

CORDON LINE
ACCURACY CHECK

EXTERNAL

FIGURE VII-5

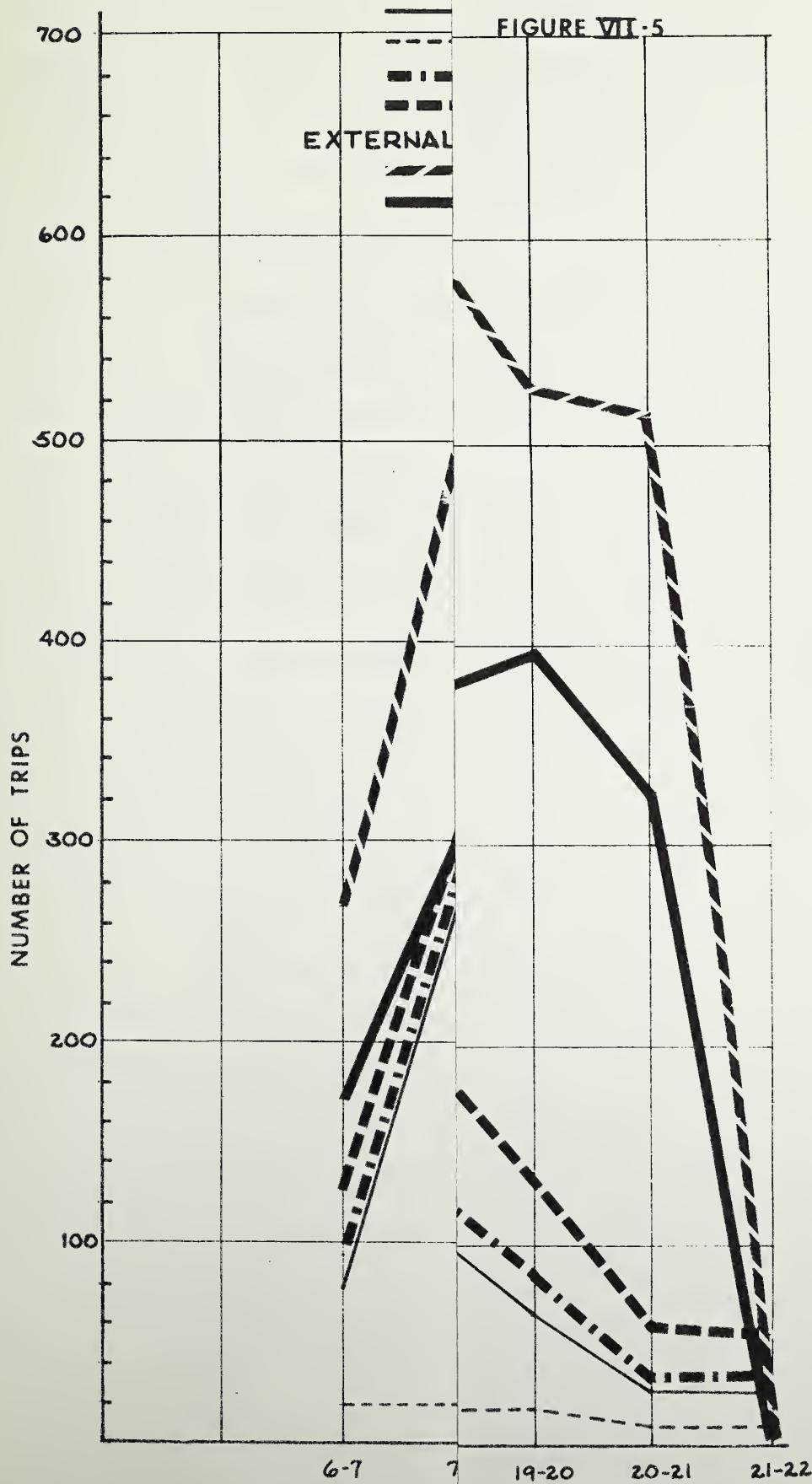
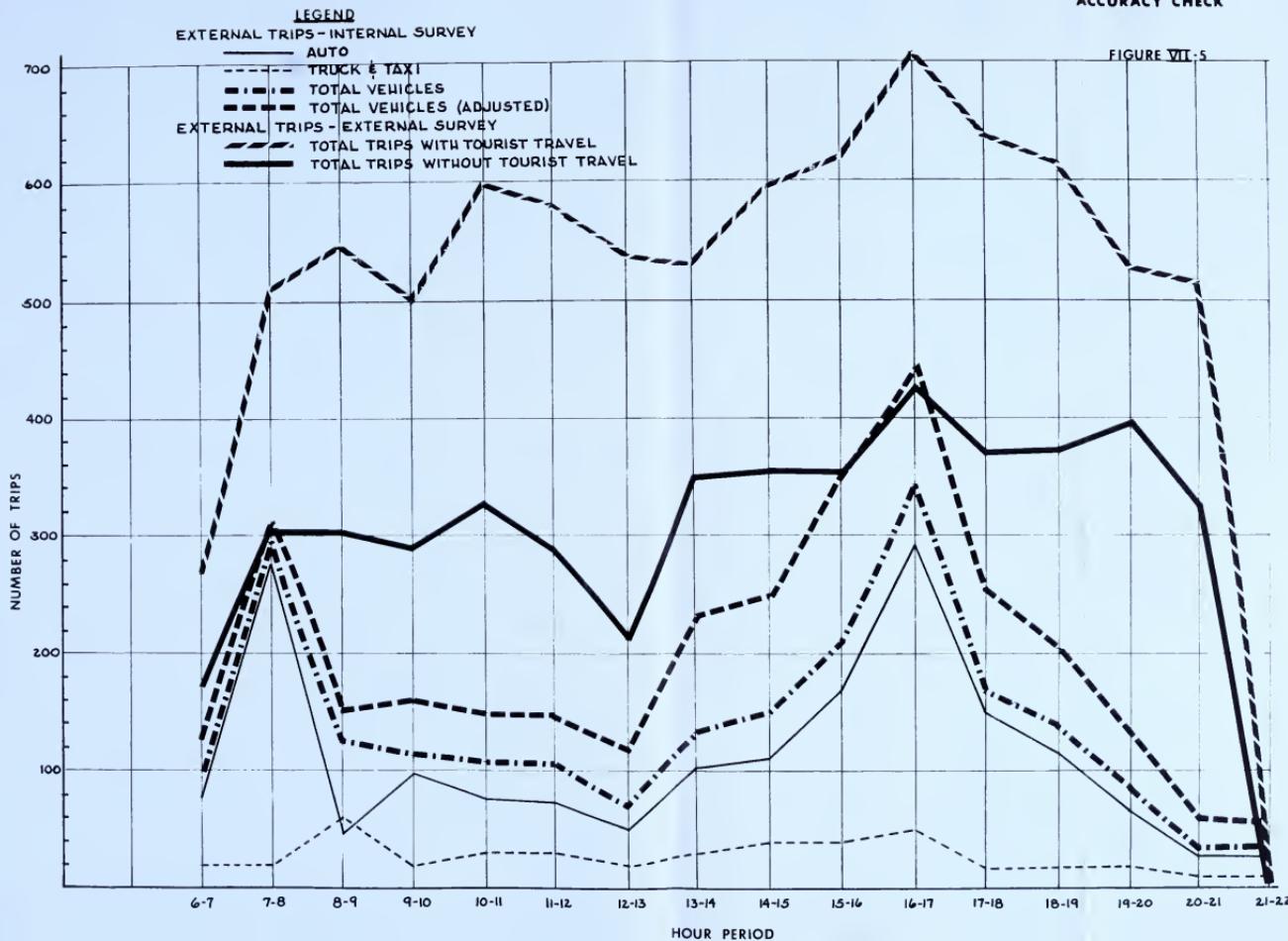


FIGURE VII-5



COMPARISON WITH OTHER STUDIES

Table VII-10 shows a comparison of various characteristics from 1965 Missoula, 1968 Great Falls and the 1970 Butte Transportation Studies.

The following characteristics can be concluded from this comparison:

- * Butte has a high number of single person households resulting in an average of 2.88 persons per household which is substantially lower than Great Falls or Missoula. This fact is substantiated by the 1970 Census which shows an unusually high number of persons over 60 years of age, 17.2 percent in Butte as compared to 11.2 and 10.9 percent in Great Falls and Missoula, respectively.
- * Vehicle ownership in Butte is comparable to Great Falls which is also an industrial city. Missoula, a university town having a higher than average median income has a large number of multi-vehicle households.
- * People in Butte average a slightly higher number of trips per day than residents of the other two cities.
- * The average occupied household in Butte generates 7.88 vehicle trips per day.
- * Butte residents make an average of 6.02 trips per vehicle each day. This is about 23 percent higher than Missoula which is to be expected because of the higher vehicle ownership in Missoula.

In summary, the Butte travel characteristics as determined from the internal survey are reasonably comparable to the other two studies. Where discrepancies exist there is a logical explanation for the difference.

TABLE VII-10
SUMMARY OF TRIP GENERATION CHARACTERISTICS

	1965 Missoula Study Area	1968 Great Falls Study Area	1970 Butte Study Area
Number of occupied households	14,610	23,354	13,680
Population	46,430	78,884	39,433
Number of vehicles owned*	25,767	30,501	17,905
Vehicle trips**	119,924	170,645	107,880
Persons per occupied household	3.18	3.38	2.88
Persons per vehicle	1.80	2.58	2.20
Vehicles per occupied household	1.76	1.31	1.31
Trips per person	2.58	2.16	2.74
Trips per occupied household	8.21	7.30	7.88
Trips per vehicle	4.65	5.60	6.02
* autos plus pickups			
** trips by area residents only			

APPENDIX



APPENDIX

L I S T O F F I G U R E S

FIGURE A- 1: Traffic Analysis Zone Boundaries

FIGURE A- 2: Traffic Analysis Zones - C.B.D.

FIGURE A- 3: Screenline and Cordon Line Stations

FIGURE A- 4: Card No. 1 - Dwelling Unit Survey

FIGURE A- 5: Card No. 2 - Internal Trip Report

FIGURE A- 6: Card No. 3 - External Trip Report

FIGURE A- 7: Card No. 4 - Truck Trip Report

FIGURE A- 8: Card No. 5 - Taxi Trip Report

FIGURE A- 9: Letter from Mario Micone, Mayor - City of Butte

FIGURE A- 10: Travel Log for Internal Trips

FIGURE A- 11: Unlisted Telephone Number Information Sheet

L I S T O F T A B L E S

TABLE A- 1: 1970 Origin - Destination Trip Table

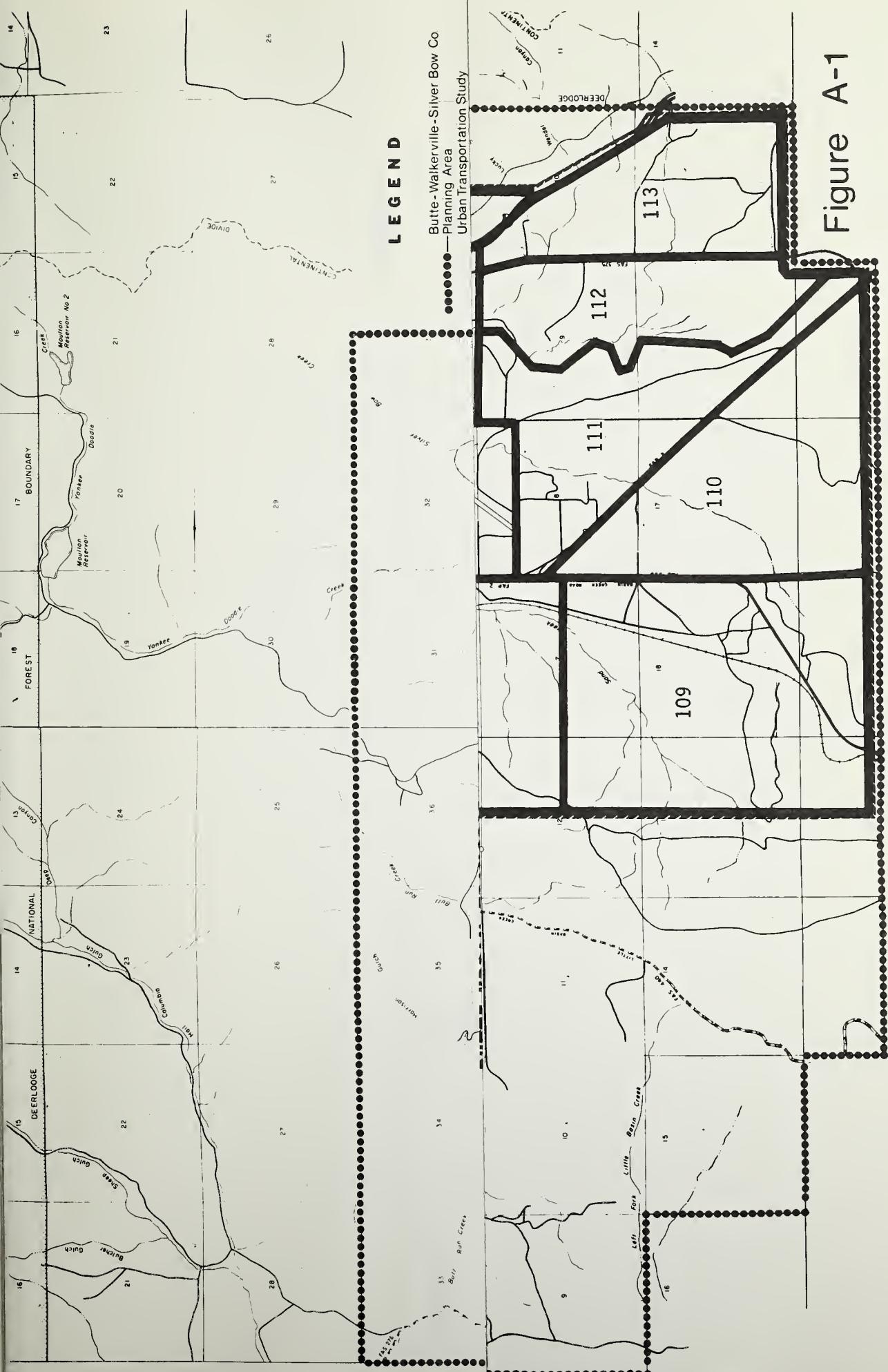


Figure A-1

E DAILY AND ASSOCIATES
HELENA, MONTANA



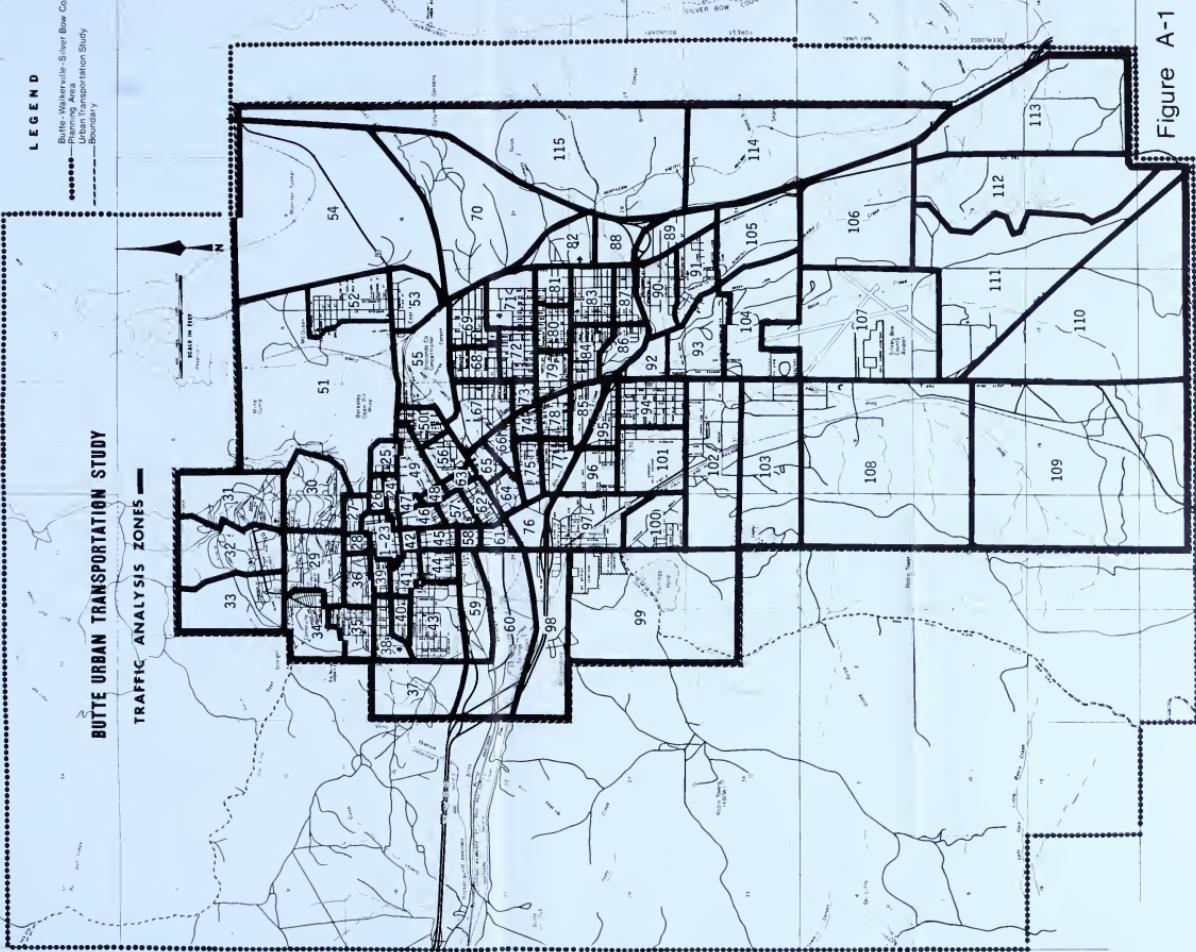
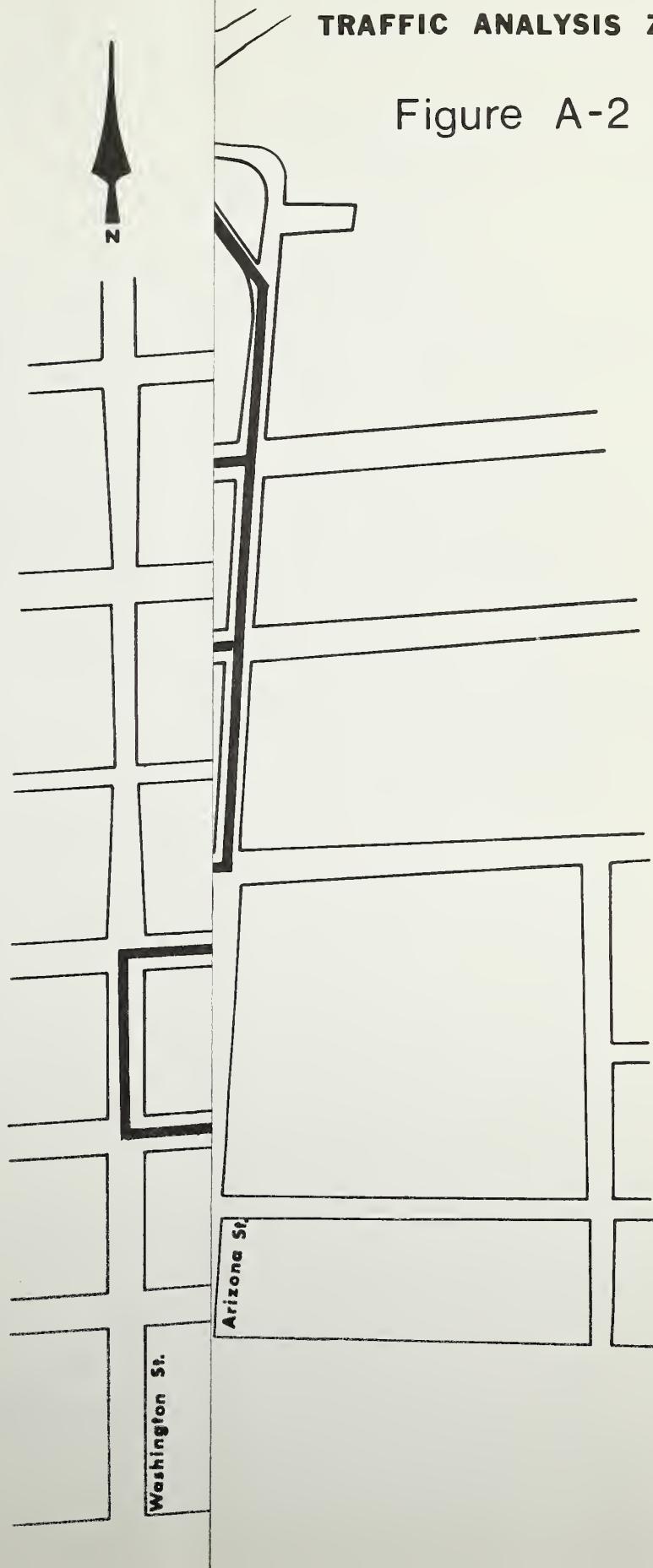


Figure A-1

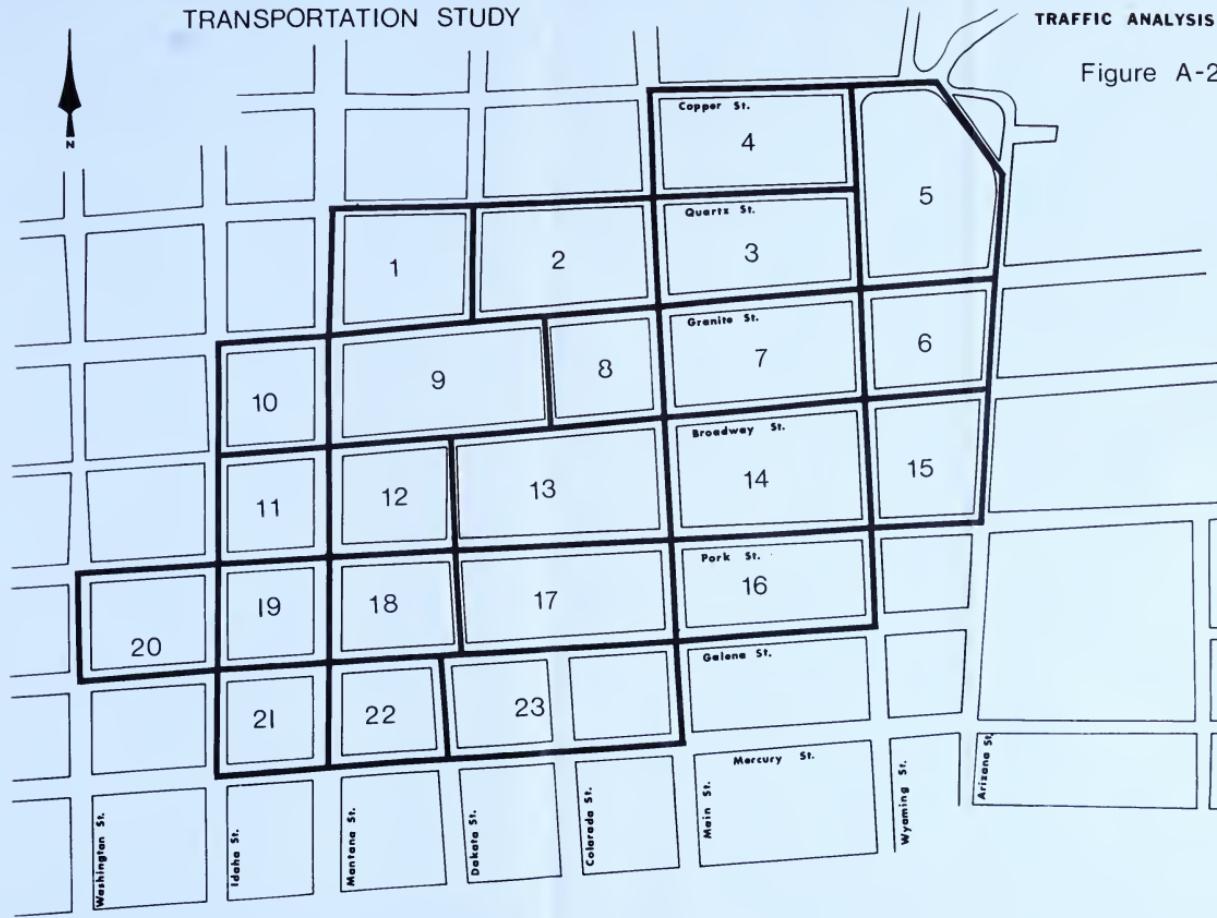
TRAFFIC ANALYSIS ZONES —

Figure A-2



BUTTE URBAN
TRANSPORTATION STUDY

TRAFFIC ANALYSIS ZONES



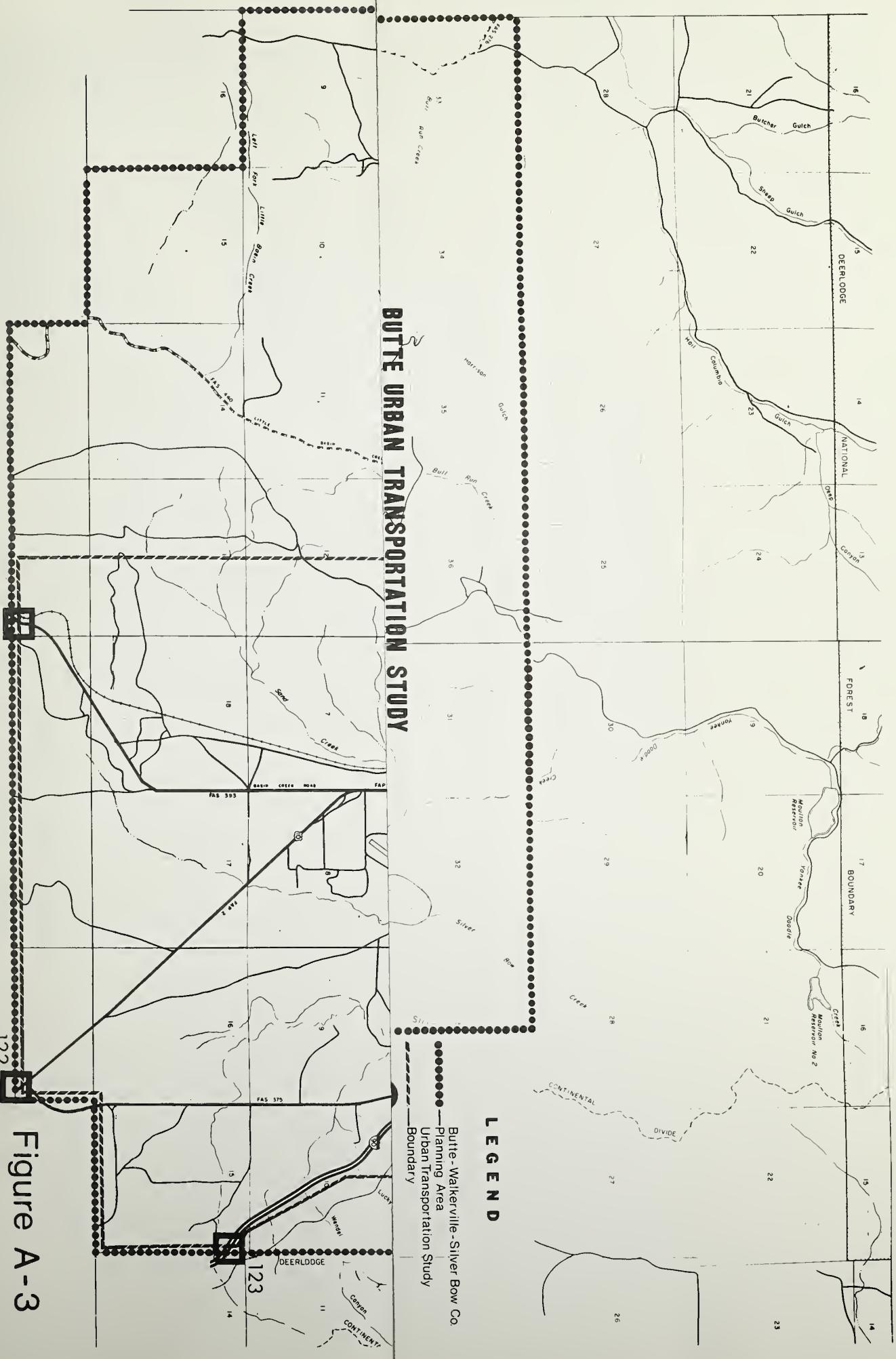
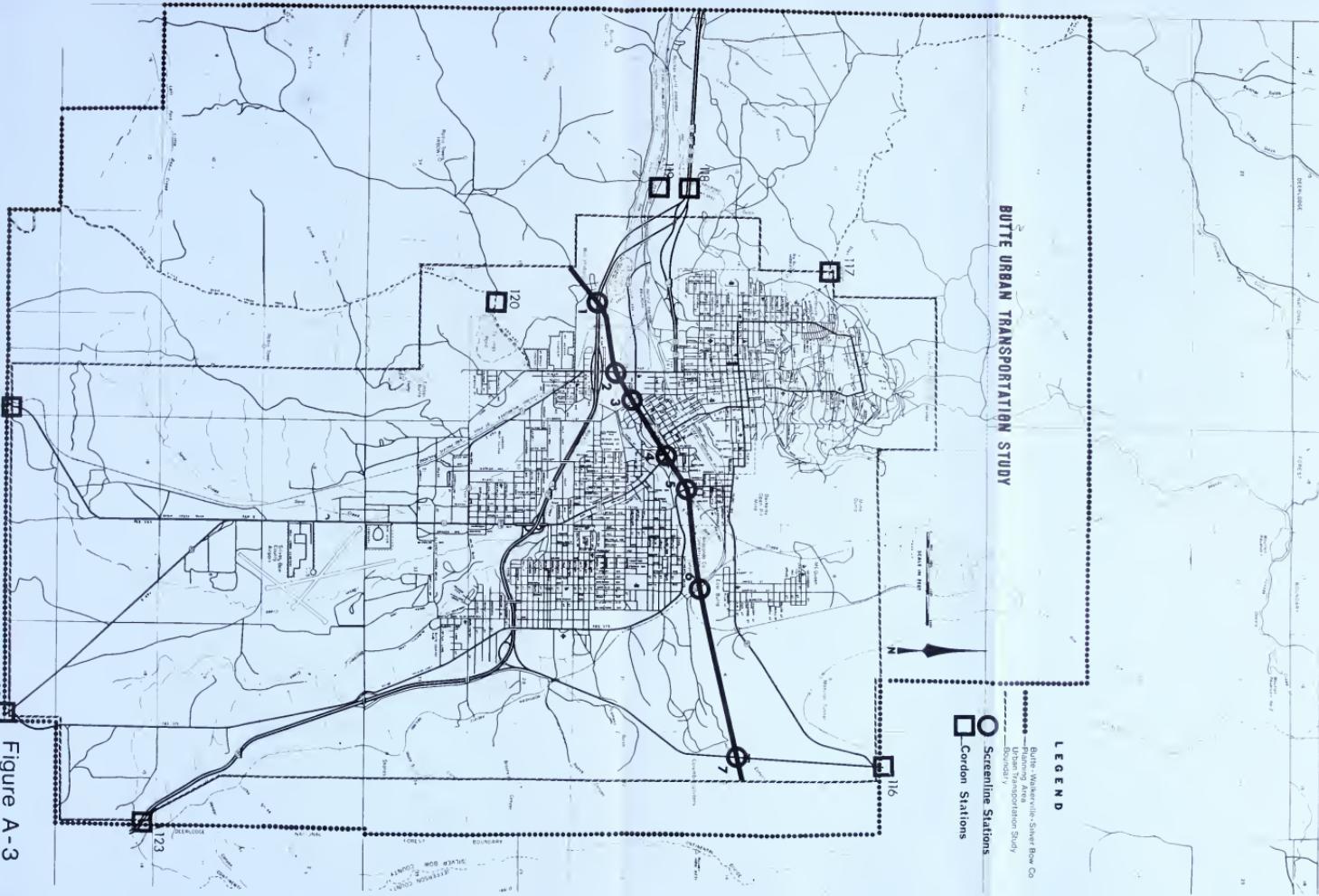


Figure A-3





DWELLING UNIT SUMMARY

INTERVIEW ADDRESS				CARD NUMBER				
LISTED OCCUPANT				CITY CODE				
PRESENT OCCUPANT				INTERVIEW NUMBER				
ASSIGNED TRAVEL DAY				WEEKDAY CODE				
LETTER RECIEVED	YES	NO	TRIP LOG USED	YES	NO	STUDY YEAR	TRACT NUMBER	
ADDRESSES OF ADJACENT NEW HOMES OCCUPIED IN PAST YEAR?				ZONE NUMBER				
				CENSUS ENUM. DISTRICT				
CALLS MADE	DATE	HOUR	INITIALS	DATE	HOUR	INITIALS		
ARE THERE OTHER RESIDENCES IN THE BUILDING IN WHICH YOU RESIDE?				PHONE				
TOTAL NUMBER OF RESIDENCES				PHONE				
TYPE OF RESIDENCE: 1. Single family unit				7. Motel				
2. Duplex unit				8. Institution				
3. Three or fourplex unit				9. Trailer				
6. Hotel				0. Mixed				
NUMBER CARS OWNED & REGULARLY OPERATED								
NUMBER PICKUPS & PANELS O. & R.O.								
NUMBER MOTORCYCLES USED REGULARLY								
NUMBER OF PERSONS RESIDING AT THIS ADDRESS					NUMBER	FIVE & OLDER		
CODING	PERS NO	PERSON IDENTIFICATION (ONLY THOSE OVER 5)	AGE	DRIVE	OCCUPATION	INDUSTRY	TRIPS ON TRAVEL DAY	
DVR STS/AGE OCC IND	Y ₁	Y ₂	Y ₃	Y ₄	Y ₅	Y ₆	Y ₇	
INTERVIEWER'S COMMENTS	1.							
2.								
3.								
4.								
SUPERVISOR'S COMMENTS	5.							
6.								
7.								
8.								
INTERVIEW STATUS	DATE	INITIALS	ANY VISITORS FROM OUT-OF TOWN WHO MADE TRIPS IN TOWN ON TRAVEL DAY	YES	NO			
INT. COMPLETED	NUMBER OF OCCUPANTS MAKING REGULAR TRIPS ON CITY TRANSIT BUSES							
INT. EDITED	NUMBER OF CAR TRIPS REPORTED AT THIS ADDRESS							
PHONE CHECKED	NUMBER PICKUP & PANEL TRIPS REPORTED AT THIS ADDRESS							
FIELD CHECKED	NUMBER MOTORCYCLE WORK OR WORK RELATED TRIPS REPORTED							
CODED	NUMBER TRIPS MADE ON CITY TRANSIT BUSES							
CODING EDITED	NUMBER DRIVERS, WITH A-D TRIPS — WITHOUT A-D TRIPS				UNKNOWN A-D TRIPS			
KEY PUNCHED	NUMBER EMPLOYED				NUMBER STUDENTS			
VERIFIED								
ERRORS CORRECTED								
FINAL INTERVIEW STATUS								
(Save this question to end of interview)								
APPROXIMATE GROSS ANNUAL INCOME OF ALL FAMILY MEMBERS	\$							
MONTANA HIGHWAY COMMISSION								

INTERNAL TRIP REPORT

EXTERNAL TRIP REPORT

MONTANA HIGHWAY COMMISSION
PLANNING SURVEY SECTION
TAXI INTERVIEW SHEET

MONTANA HIGHWAY COMMISSION PLANNING SURVEY SECTION TAXI INTERVIEW SHEET			
Owner _____	Address _____	Year of Mfg. _____	Sample No. _____
License No. _____	Cab No. _____	Make _____	Card No. 5
Date of Travel _____	Day of week _____	Interviewer _____ Sheet _____ of _____	
Total Number of Days _____	Total Number of Stops or Trips _____	_____	
Estimated Miles _____	Mileage within Area _____	_____	



**MARIO MICONE, MAYOR
CITY OF BUTTE**

Dear Citizen:

The Butte City-County Planning Board, in cooperation with the Montana Highway Commission and the Bureau of Public Roads, is in the process of preparing a comprehensive plan to guide the future development of roadways in the Butte area. Your household has been selected on a random basis for the purpose of obtaining current information on daily travel within the area. What this will mean to you, as a citizen, is a better community served by improved streets and highways.

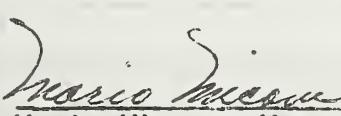
Sometime between the hours of 10:00 A.M. and 9:00 P.M., within two days after the date given below, an interviewer will contact you by telephone or in person. After identifying herself she will ask you questions pertaining to travel by members of your family on that travel date. Your answers will be treated confidentially.

Enclosed is a set of travel log forms. Directions for their use are printed on the back of each form. It would be very helpful, and will reduce the interview time required, if you will log all travel for the travel date prior to the interview.

Your cooperation in furnishing the information requested by the interviewer will be greatly appreciated.

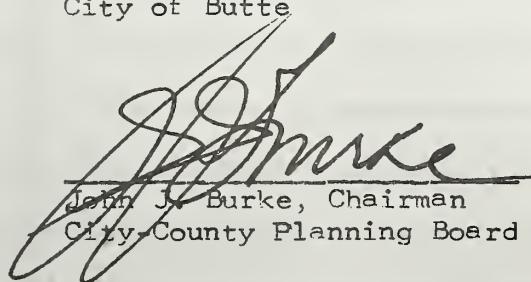
If you have any questions, please call 792-3093.

Yours very truly,


Mario Micone

Mario Micone, Mayor
City of Butte

Travel Date


John J. Burke, Chairman
City-County Planning Board

B U T T E U R B A N T R A N S P O R T A T I O N S T U D Y

TRAVEL LOG for all trips made by _____
 (Name of Driver)

During the 24-hour period of _____
 (Travel Date)

(For Instructions See Back)

TRIP NO.	WHERE DID TRIP BEGIN?	TIME BEGAN	WHERE DID TRIP END?	TIME ENDED	NO. OF PEOPLE IN VEH.
1	From	AM PM	To	AM PM	
2	From	AM PM	To	AM PM	
3	From	AM PM	To	AM PM	
4	From	AM PM	To	AM PM	
5	From	AM PM	To	AM PM	
6	From	AM PM	To	AM PM	
7	From	AM PM	To	AM PM	
8	From	AM PM	To	AM PM	
9	From	AM PM	To	AM PM	
10	From	AM PM	To	AM PM	
11	From	AM PM	To	AM PM	
12	From	AM PM	To	AM PM	
13	From	AM PM	To	AM PM	
14	From	AM PM	To	AM PM	
15	From	AM PM	To	AM PM	
16	From	AM PM	To	AM PM	
17	From	AM PM	To	AM PM	
18	From	AM PM	To	AM PM	
19	From	AM PM	To	AM PM	
20	From	AM PM	To	AM PM	

WHAT IS THIS STUDY ALL ABOUT?

The purpose of this Transportation Study is to determine existing and future street and highway needs in the Butte area. To do this, vehicle trip information is being gathered in three ways: (1) by interviewing motorists at roadside locations, (2) by interviewing families who live in the study area, and (3) by interviewing the owners of trucks and taxis based within the area. The information obtained from these interviews permits careful planning of streets and highways to help meet your transportation needs.

WHAT INFORMATION IS DESIRED?

In order for the vehicle trip information to be usable, it must be complete. Therefore, we need a list of all of the trips made by each member of your family who drives any vehicle on the designated travel date. For each trip we need to know: (1) where the trip began, (2) the time it started, (3) where the trip ended, (4) the time it ended, and (5) the number of persons in the vehicle. Any trip made in a vehicle not driven by a member of your household need not be reported.

HOW TO USE YOUR TRAVEL LOG.

For your convenience, we have provided you with several travel logs. It would be desirable if each driver of your household would complete a separate log of his or her trips. If a sufficient number of travel logs has not been enclosed, please use blank sheets of paper. Please do not mail your travel logs, but have them close by the telephone on the day following the travel date. Your interviewer, who will call either by phone or in person, is trained to record the desired information quickly.

WHAT IS A TRIP?

A trip has both a starting place and an ending place with no important stops between. Usually, at the end of a trip, either the driver or a passenger gets out of the vehicle. A trip could end, however, at a drive-in bank, drive-in restaurant, drive-in theatre, a post office mailbox, or even a service station, with no one actually getting out of the vehicle. If a trip is strictly for pleasure, the farthest point traveled to and possibly several major points along the way should be recorded.

The trips made by a typical family on a normal weekday might be as follows:

<u>Trip No.</u>	<u>Trip Began</u>	<u>Time</u>	<u>Trip Ended</u>	<u>Time</u>	<u>Number of People in The Vehicle</u>
1	Home Address	8:30 A.M.	School Name	8:45 A.M.	3
2	School Name	8:45 A.M.	Work Address	9:00 A.M.	1
3	Work Address	5:00 P.M.	205 W. Broadway	5:15 P.M.	1
4	205 W. Broadway	5:30 P.M.	Home Address	5:45 P.M.	1

The trips shown here are only examples used to illustrate the proper use of the travel log. In reality, there is no typical family, and the number and purpose of trips can vary widely. Our concern is not with trips you would normally make, but only with those that you happen to make on the designated travel day.

Your assistance and cooperation are deeply appreciated. If you have any questions, or if we can assist you in any way with the travel log, please call us at 792-3093.

BUTTE TRANSPORTATION STUDY
Telephone 792-3093

TO PERSONS WITH UNLISTED TELEPHONE NUMBERS

We would appreciate a telephone call from you on _____ so that we may complete the interview scheduled for your residence. Please call anytime during our mid-day shift of 10 a.m. to 2 p.m., or during our evening shift of 4 p.m. to 8 p.m.

Your prompt reply will save us the time and expense of sending a member of our staff to your door to complete the interview. Your cooperation is appreciated and the interview will be promptly and efficiently taken.

TO PERSONS WORKING NIGHT SHIFTS

As our office and interviewing hours are 10 a.m. to 2 p.m. and 4 p.m. to 8 p.m., we very likely will be calling your residence during those hours and disturbing your sleep. If this is the case, please give us a call at your earliest convenience (immediately, if possible) and we will be glad to schedule the interview for a more suitable day or hour. The interview for your residence is scheduled for _____ and our first telephone calls on that date will be made between 11 a.m. and noon.

Butte Urban Transportation Study 1970 Total Origin and Destination Trips

Table A-1 (continued)
Butte Urban Transportation Study
1970 Total Origin and Destination Trip

Table A-1 (continued)
Butte Urban Transportation Study
1970 Total Origin and Destination Trips

Table A-1 (continued)
 Butte Urban Transportation Study
 1970 Total Origin and Destination Trips

